IBM Office Products Division
Customer Engineering

SERVICE MANUAL

"SELECTRIC" TYPEWRITER

Models 7X1 – 7X3 – 7X5 – 8X3 – 8X5

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"SELECTRIC" TYPEWRITER
"SELECTRIC" II TYPEWRITER
SERVICE MANUAL CONTENTS
(Alphabetical)

Page

FUNCTIONAL CHECK
"Selectric" Typewriter 2
"Selectric" II Typewriter – Dual Pitch 134
INTRODUCTION 1
MECHANISM OPERATION & ADJUSTMENTS
Backspace
Express Backspace 157
Half Backspace 141
Rotary Backspace 151
Single Pitch Backspace 52
Carrier Return 63
Character Selection
Rotate 31
Tilt 29
Covers 113
Drive Mechanism 5
Escapement 39
Escapement, Dual Pitch 143
Fine Alignment 23
Index 81
Keyboard 12
Margins and Linelock 109
Operational Control and Spacebar 45
Paperfeed and Index 81
Print 70
Ribbon
Fabric Ribbon 101
Film Ribbon 91
Selective Ribbon 160
Spacebar 45
Shift 18
Switch Pitch 136
Tabulation Single Pitch 55
Tabulation – Dual Pitch 143
PREFACE II
REMOVAL PROCEDURES
Carrier and Rocker Assembly Removal 130
Carrier Return/Backspace Cable Drum Assembly Removal – Dual Pitch 171
Cord Replacement 133
Cover Removal 130
Cycle Clutch and Cycle Shaft Removal 132
Drive Belt Removal 132
Escapement Rack Removal – Dual Pitch 171
Escapement Pawl Removal 131
Keyboard Interposer Removal 132
Lubrication Guide 133
Margin Rack & Rail – Dual Pitch 171
Operational Shaft Removal 131
Print Sleeve Removal 131
Rocker Assembly Removal 130
Rotate Selection Differential Removal 132
Rotate Spring Replacement 131
Rotate Tape Replacement 133
Shift Cam Removal 132
Tilt Ring and Rotate Shaft Removal 130
SPECIAL MACHINE FEATURES
Card Holding Platen 117
Dead Key Disconnect Mechanism 120
Dead Key Mechanism 118
Double Indexing Device 121
External Ribbon Control 122
Manual Velocity Control 123
Pin Feed Platen 125
Shift Sensing Mechanism 127
Stroke Counter 129

PREFACE

This manual was published to be used by Customer Engineers and other technically oriented individuals as a reference source to aid in servicing the "Selectric" and "Selectric" II Typewriters. This manual covers Models 7X1, 7X3, 7X5, 8X3, and 8X5 and was written with the restraint that the persons using the manual will have already become familiar with the machine from the operator's viewpoint.

The Parts Catalog and the Pictorial Reference/Adjustment Manual are recommended to be used in conjunction with this manual. There are three special tools that are also required. They are the Hooverometer, platen gauge and hand cycling wheel. The use of the Hooverometer and platen gauge are self-evident in the adjustments that require their use. The hand cycling wheel fits into the right end of the operational shaft and is used to operate the machine by hand to view an adjustment or the mechanism operation. The hand cycling wheel should be turned top to front.

In reprinting this manual, the "Selectric" II Typewriter supplement has been added inside this cover for convenience and begins on page 134.

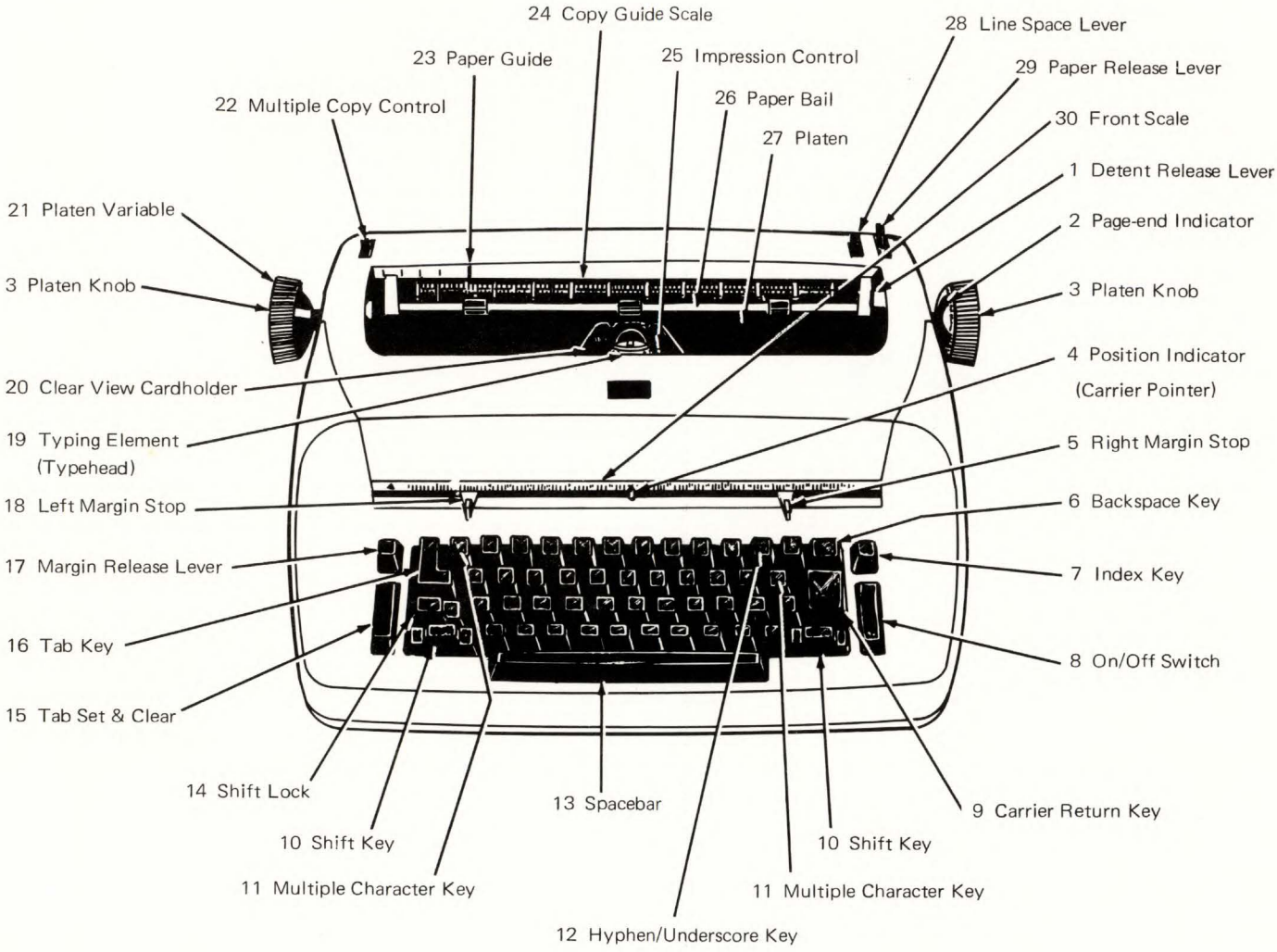
The IBM "Selectric" Typewriter is available with film or fabric ribbon and features a small sphere-shaped typing element that eliminates type clashing. The typing element is easily removed to permit changing the typestyle to best suit the application. An impression control permits the operator to vary the impression of the typing element. An automatic velocity control changes the impression of the characters located in certain keyboard positions to a lighter impression regardless of the position of the impression control. A stroke storage mechanism reduces typing errors by storing the second of two rapidly typed characters until the first is printed out. The paper mechanism remains stationary and the element moves across the paper. The underscore, backspace, spacebar, index key and carrier return are typamatic keys.

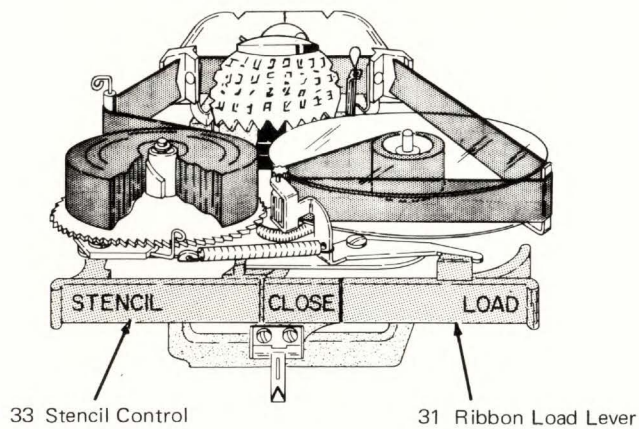
The applications of the "Selectric" Typewriter include all types of general correspondence, preparation of master copy for most types of duplicating, carbon copies, stencil writing and formswriting. The machine is also available with minor changes in the element, keyboard and cardholder for Optical Character Recognition applications.

The IBM "Selectric" II Typewriter adds a new dimension of versatility to the IBM "Selectric" Typewriter Product line. In addition to its regular "Selectric" Typewriter features of single element printing and non-moving carriage, the IBM "Selectric" II Typewriter is available in either single pitch or dual pitch escapement. It has a new appearance and also includes such other major new features as: (1) Selective ribbon system, (2) Express backspace, and (3) Half-backspace (dual pitch models only).

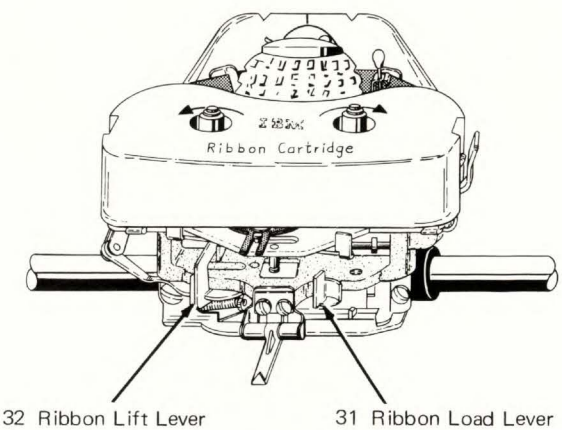
1. *Dual Pitch* – Allows the operator to select the typestyle and spacing best suited to the application – whether it is correspondence, manifolding, OCR speech writing, legal, file indexes, or other.
2. *Selective Ribbon System* – Allows the use of film ribbon or the new IBM Tech III ribbon, both contained in cartridges for easier and fewer changes. The IBM Tech III ribbon creates a high quality more uniform image on a wider range of surfaces with an extremely high character yield.
3. *Express Backspace* – Moves the carrier to the left quickly, under complete control of the operator, while remaining on the same writing line.
4. *Half-Backspace (Dual Pitch Only)* – Permits typing half way between two characters or spaces allowing the operator to "squeeze-in" a character.

This functional check is a procedure that will tell you whether or not an IBM "Selectric" Typewriter has any malfunctions. It includes checks of every function of the machine, organized in an efficient sequence.





Film Ribbon



Fabric Ribbon

Operator Controls

1. *Visual Inspection* – Look at the machine carefully for any obviously loose, damaged, or missing parts. Also look for foreign material in the machine: pencils, erasers, paper clips, etc.
2. *On-Off Switch* – Operate the on-off switch (8) several times. Switch action should be positive and the machine should reliably turn on and off.

   Turn the switch off. Try to depress all of the character keybuttons. All characters except the hyphen/underscore (12) should be locked. No character should print when the machine is turned back on.

   Turn the switch on and unplug the machine. Depress all functional keys: tab (16), shift (10), spacebar (13), backspace (6) and carrier return (9). Plug the machine in. The machine should start reliably under this load.
3. *Paper Insertion* – Roll a single piece of paper into your machine. It should not wrinkle or tear.
4. *Paper Release* – Pull the paper bail (26) forward. Notice that the feed rolls still hold the paper firmly. Now, pull the paper release lever (29) forward. You should be able to easily position the paper left and right.
5. *Multiple Copy Control Lever* – Operate the multiple copy control lever (22) while watching the platen (27). The platen should noticeably move front and rear. The lever should not bind at either extreme position. Return the lever all the way forward.
6. *Detent Release* – Push the detent release lever (1) down. The platen should rotate freely without any detenting action. Push the detent release lever up. The platen should now be positively detented.
7. *Platen Variable* – Push in on the left platen knob (21). The platen should turn freely. Be sure the ratchet on the right side of the platen does not turn. When the knob is released, it should restore reliably.
8. *Margin Set* – Position the carrier at 30. Move the left margin (18) to the right until it lines up with the carrier pointer (4). Then, operate the carrier return. The margin should remain at 30. Type over to the right margin (5). The bell should ring 10-12 spaces before the carrier reaches the right margin. When the carrier pointer reaches the right margin, the character keys should lock.
9. *Margin Release* – Set the left margin at 25. Carrier return to the left margin. Depress and release the margin release keybutton (17). Operate the carrier return again. The carrier should move to the extreme left. Now type from zero to position 30. You should be able to type through the left margin.

Carrier Movement

1. *Spacebar* – Return the carrier to the left margin. Check the spacebar by first typing a series of lower case "n's" separated by a space. Then, return to the margin, roll back to the same writing line and substitute a space for the "n's" and the letter "X" for the space. You should have a line of alternate "n's" and "x's" evenly spaced.

   Check to see that the spacebar repeats when slight additional pressure is applied to the keybutton. Starting at position 0, hold the spacebar in a repeat operation as you watch the carrier move to the extreme right limit. The speed of the carrier should remain constant from position 0 to position 130.
2. *Backspace* – Turn the paper in your machine sideways; then, starting with the carrier at 115 on the front scale type a row of "h's" and "n's" alternately for a total of ten characters. Now, backspace 10 spaces and retype the same characters. The characters should overlay each other.

   Also, check the backspace in a similar manner with the carrier positioned at 10 and 60 on the front scale.

   Check to see that the backspace mechanism repeats when slight additional pressure is applied to the keybutton.
3. *Carrier Return* – Operate the return key (9) with the carrier positioned two, three and four inches from the left margin. Check for reliable single and double linespace during this operation. The carrier should not hesitate at the margin or appear sluggish.

   Check to see that only the index portion of the carrier return operation is repeated when slight additional pressure is applied to the keybutton.
4. *Index* – Operate the index key (7). Check for reliable single and repeat operation. The carrier should not move during an index operation.
5. *Tab* – Clear all tab stops (15). Now set tabs at 55, 56, 88 and 90. Operate the tab and check to see that the carrier stops exactly at 55, 56, 88 and 90. Make this check several times.

   Now tab all the way to the right. Hold down the tab clear keybutton and operate the carrier return. All the set tab stops should clear automatically without excessive noise.

1. *Strike-up* – Set the impression control lever (25) at 3. Make a strike-up of all the characters on the keyboard in the following manner: type one character, then an "H"; another character, and an "H", etc., until you have typed every character in upper and lower case. Make this strike-up several times. First, use a very slow and deliberate touch, then a heavy, rapid touch. Remember, every operator has a slightly different touch. You should meet the following conditions, regardless of how you vary the touch.
   A. All keys should have printed the correct character.

   B. All characters should have even color.

   C. No characters should be obviously out of position.

   D. There should be even spacing between characters with no overlap.

   E. All keybuttons should move down easily and the correct character should print before the keybutton bottoms.
2. *Repeat Characters* – Lightly depress the hyphen/underscore keybutton. The characters should print once for a single depression. The character should repeat when more pressure is applied. You should not be able to stall the repeat operation by pushing down hard on the keybutton.
3. *Impression Control* – Type a letter character with the impression control lever at 1 and at 5. You should hear a noticeable difference in the sound of the typehead (19) hitting the paper. Return the impression control lever to 3.
4. *Linespacing* – Type several lines of underscores in both linespace lever (28) position. The space between the typed lines should be even for both linespace lever positions.
5. *Scales* – Type a line of upper case V's. The horizontal line on the card holder (20) should be parallel to the line of V's.

   The points of the V's should line up with the vertical lines on the card holder.

   Set the left margin as far to the left as it will go. Operate the carrier return. The pointer should line up with zero on the front scale (30).
6. *Type alternate upper and lower case Z's. The characters should print properly with even spacing.*

   Slowly depress the shift lock (14). The button should lock down just as or slightly after a shift occurs.

   Lock the shift in upper case and type a full line of underscores. The lock should not release by vibration.

   The shift should unlock when either shift button is lightly depressed.
7. *Film Ribbon Operation* – Look at the ribbon and the typed samples. The pattern on the ribbon should look similar to this.

   There should be neither character overlap on the ribbon nor voids (white spaces) on the printed characters. Depress the stencil control (33) and type a few underscores. The ribbon should not feed and the underscore should miss the ribbon. Return the stencil control to its normal position.
8. *Fabric Ribbon Operation* – Type a series of underscores with the impression control lever set on five and the ribbon lift lever (32) in the high lift position. Look at the position the underscore printed on the ribbon. It should be near the bottom and all underscores should print on the ribbon. If a black and red ribbon is used, all characters must print black when the ribbon lift lever is in the low lift position. All characters must print red when the lift lever is in the high lift position. When the lift lever is in the stencil position, the underscore must not print on the top of the ribbon.

   Remove the ribbon cartridge. Depress the repeat underscore and note which ribbon feed ratchet is rotating. Turn the other feed ratchet in the **same** direction while depressing the repeat underscore. The ribbon mechanism must reverse and drive the opposite spool. Repeat the procedure for the other spool.

Reset the margins and tab stops as they were when you started. This concludes the detailed functional check.

DRIVE MECHANISM OPERATIONAL THEORY

The drive mechanism supplies the power and timing to the cycle shaft, filter shaft and print shaft. The shaded pole motor and an eight-toothed motor pulley provide positive drive for the machine operation. (Fig. 1)

To ensure the motor will be allowed to start under a heavy load, a centrifugal clutch is incorporated into the motor pulley design. The motor is allowed to approach normal operating speed before the clutch engages the drive mechanism. The momentum developed by the motor causes the machine to start even though several mechanisms may have been tripped with the machine "OFF".

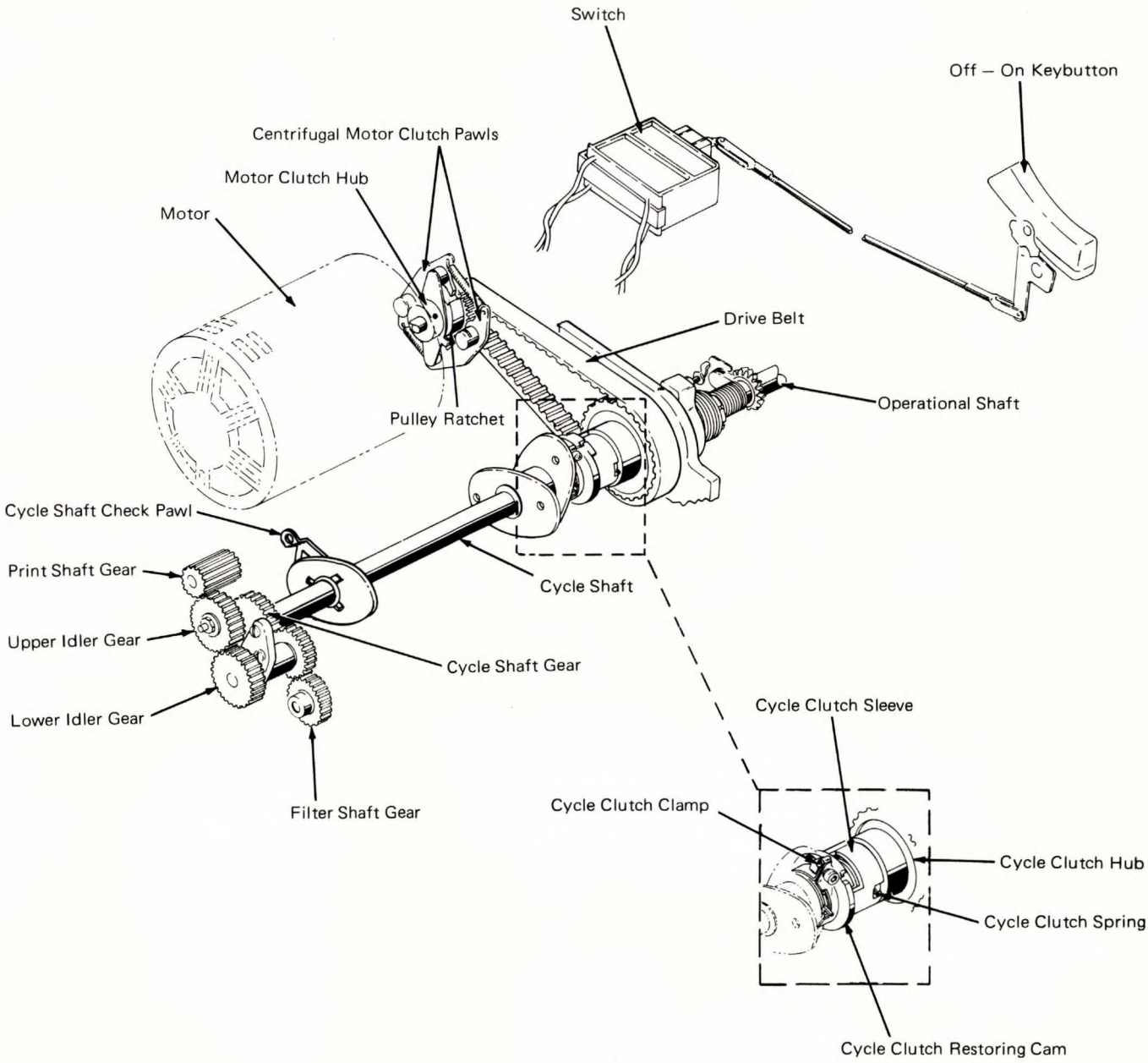


Figure 1 – Drive Mechanism

A clutch plate hub assembly is setscrewed to the shaft of the motor just left of the motor pulley. Two clutch pawls pivot on the clutch plate hub assembly. (Fig. 2) When the motor is "OFF", the pawls are spring loaded against stop lugs on the clutch plate. When the motor is turned "ON", centrifugal force causes the clutch pawls to pivot on the clutch plate so the tip of one of the two pawls will engage a tooth on the motor pulley. The pulley is then caused to rotate and drive the machine by the cycle clutch pulley.

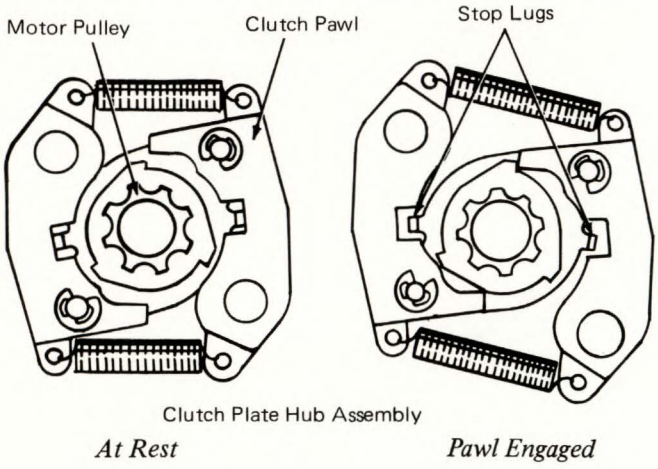


Figure 2 – Motor Pulley Clutch

A plastic bushing surrounds the motor shaft inside the motor pulley. This bushing serves to keep the motor pulley from "freezing" to the motor shaft and causing the motor to fail to start. (Fig. 3)

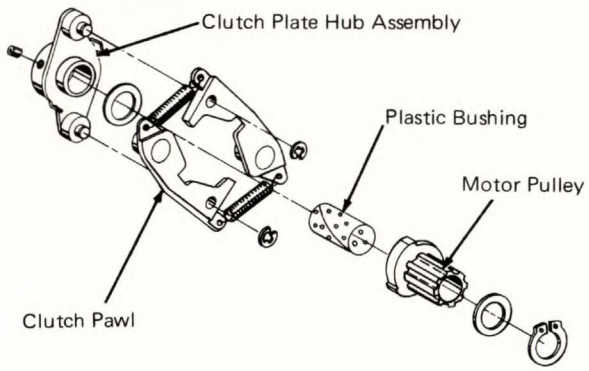


Figure 3 – Motor Clutch Assembly

The cycle clutch pulley is molded to a hub and is continuously rotating within a bronze bearing in the center of the power frame. Two shafts extend into, and are supported by the hub on each side of the cycle clutch pulley. The shaft on the right called the operational cam shaft, is in constant rotation with the cycle clutch hub. All powered functional operations are driven by this shaft. The driving connection between the cycle clutch pulley hub and the operational shaft is made by two extensions of the pulley hub that fit into cut-outs in the left side of the torque limiter hub. The level 1 torque limiter hub had two nylon inserts that fit into the cut-outs of the torque limiter hub, around the extensions of the cycle clutch pulley hub, to provide a noiseless driving connection between the two hubs. (Fig. 4)

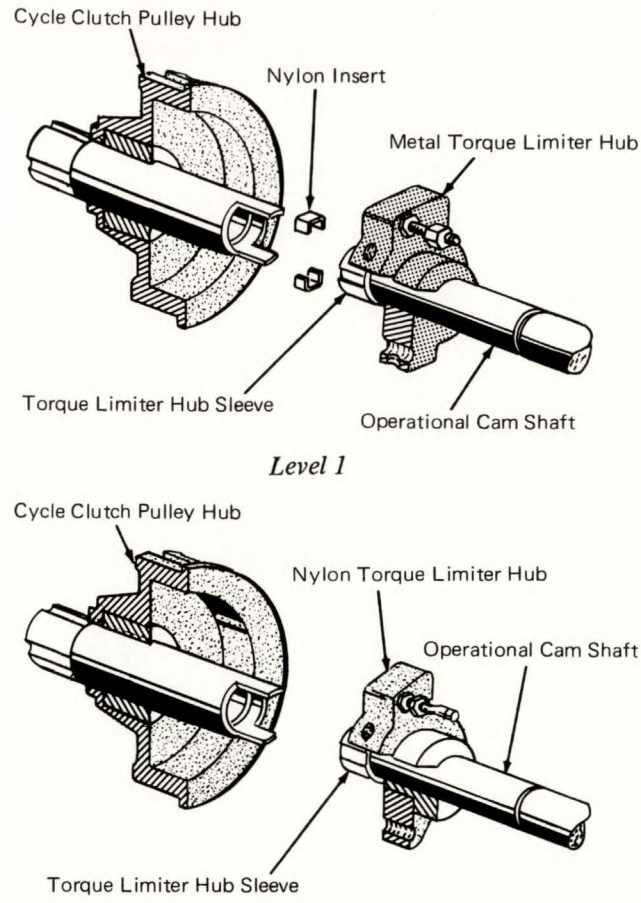


Figure 4 – Operational Cam Shaft Drive Connection

The shaft to the left of the cycle clutch pulley hub is the cycle shaft. The cycle shaft is driven by means of a spring clutch and only turns whenever a letter keylever is depressed. Its rotation is restricted to 180 deg. for each character cycle. After 180 deg. rotation, the spring clutch is disengaged allowing the shaft to remain stationary. (Fig. 5)

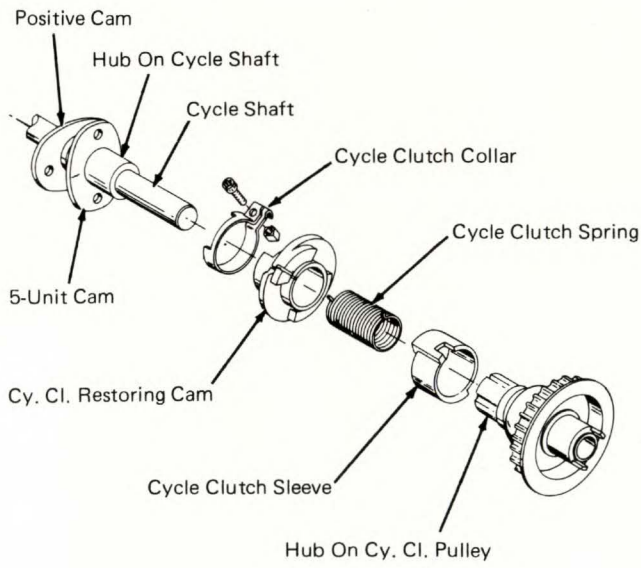


Figure 5 – Cycle Clutch Exploded View

The control for starting and stopping the cycle shaft is the cycle clutch which uses a "helical spring" type of drive.

If the turned up ear on the right end of the spring (Fig. 6) were held stationary, and the left end turned in the direction shown by the arrow, the spring would tend to unwind and the inside diameter would become larger. If the left end of the spring was held in this position and the right end turned loose, the spring would wind up under its own tension and the inside diameter would become smaller.

The clutch arbor surface of the cycle clutch pulley hub is slightly larger than the inside diameter of the spring when the spring is in its relaxed state. With the spring held in its unwound position, its inside diameter is large enough so the driving arbor will fit inside and have clearance. If the right end of the spring were released, the spring would wind up on the driving arbor and be turned further in a winding direction, in turn driving anything attached to the left end of the spring. If the right end of the spring were stopped and the left end continued to turn, the diameter of the spring would increase and would no longer be driven by the driving arbor.

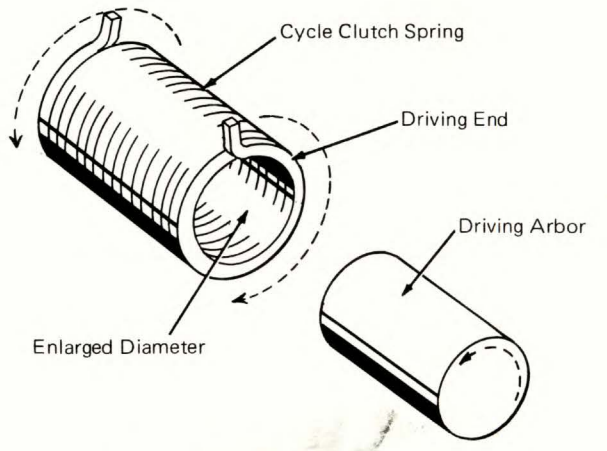


Figure 6 – Cycle Clutch Spring

The right end of the cycle clutch spring fits through a cycle clutch sleeve. The turned up ear fits into a notch on the right side of the cycle clutch sleeve. If the cycle clutch sleeve is stopped, the right end of the spring is stopped. The left end of the cycle clutch spring fits over the cycle shaft and is clamped securely to the cycle shaft by an adjustable clamp. (Fig. 7)

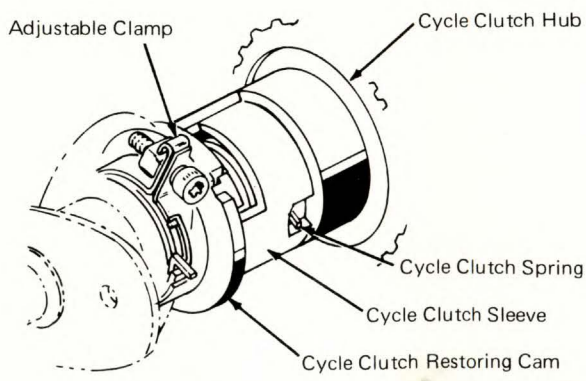


Figure 7 – Cycle Clutch Mechanism

Starting and stopping the cycle shaft is dependent upon controlling the expansion and contraction of the spring. As the shaft and clutch turn, top to front, one of the latch surfaces on the cycle clutch sleeve contacts the cycle clutch latch. This will stop the cycle clutch sleeve and right end of the cycle clutch spring completing 180 deg. of rotation. (Fig. 8)

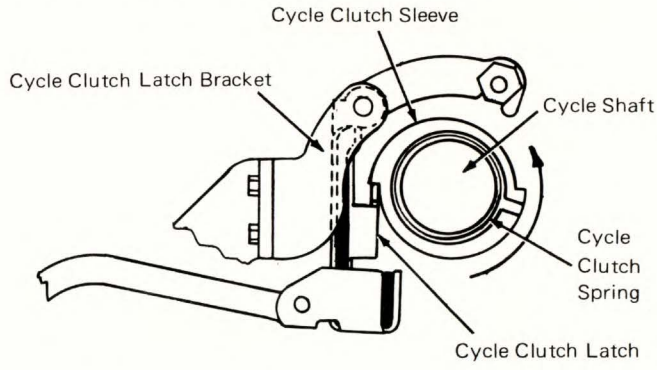


Figure 8 – Cycle Clutch Latch – Side View

The cycle shaft has inertia and tends to keep turning even though the sleeve has stopped. The result is the spring unwinds and is expanded to a point where the hub is no longer driving the spring. A cycle clutch check pawl is mounted at the extreme left end of the cycle shaft on the inside of the left casting. The inertia of the shaft expands the cycle clutch spring and at the same time allows the check pawl to drop into its latch surface. The left end of the spring is now fixed so the cycle shaft cannot turn backwards and allow the spring to engage on the hub. (Fig. 9)

When another cycle is desired, all that is needed is to pull the cycle clutch latch free of the sleeve. This will allow the right end of the cycle clutch spring to wind up, grab the hub and go through another cycle. When the step on the opposite side of the sleeve engages the cycle clutch latch, the right end of the spring will be stopped and the cycle shaft will overthrow and the check pawl will drop in. The cycle shaft is now in a latched position.

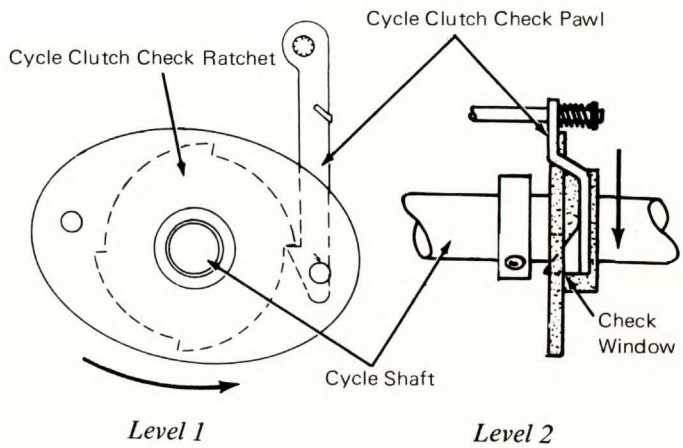


Figure 9 – Cycle Clutch Check Pawl

A gear setscrewed to the left end of the cycle shaft drives the filter shaft and the print shaft each time it operates. The filter shaft operates the character selection mechanism, the print escapement mechanism, the shift interlock and a spacebar interlock. The print shaft operates the print mechanism, fine alignment mechanism, and the ribbon feed and lift mechanisms. (Fig. 10)

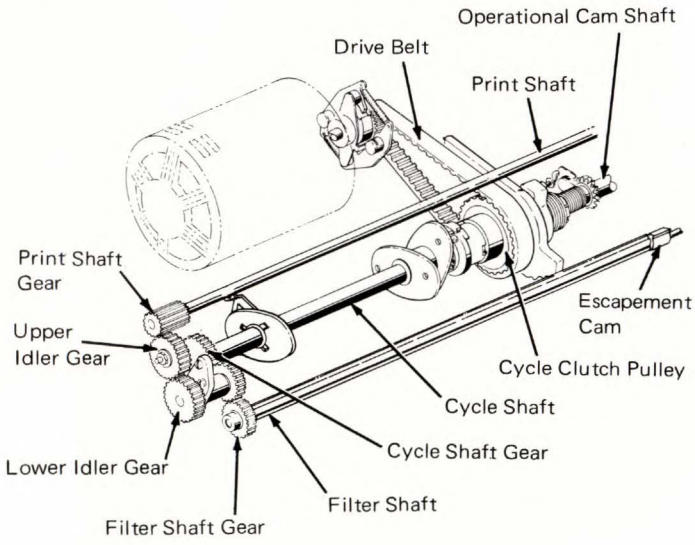


Figure 10 – Drive Mechanism

The motor used in the "Selectric" typewriter is a 3" shaded pole, induction type motor that normally requires 115 volts, 60 Hz (other voltages are available). The motor is mounted at the left rear of the machine with the pulley toward the right. It is attached to an adjustable bracket at each end by ring shaped spring retainers that encircle the rubber motor mounts. (Fig. 11)

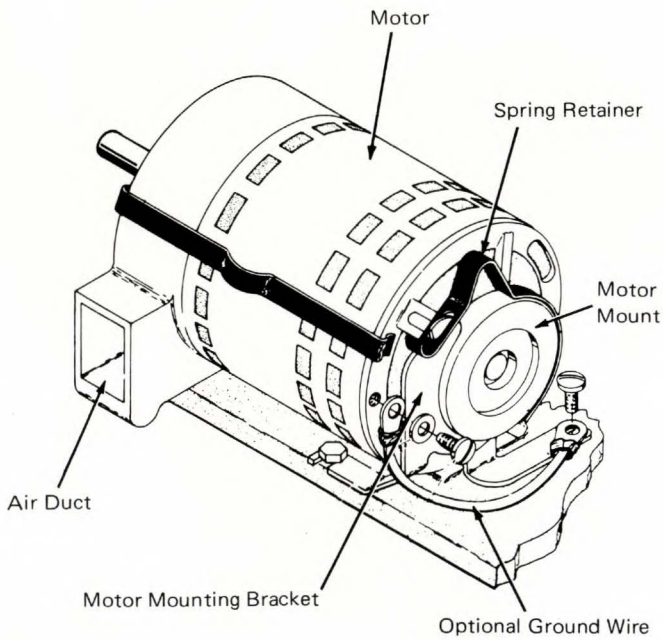
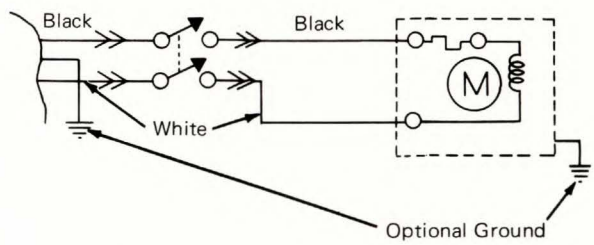
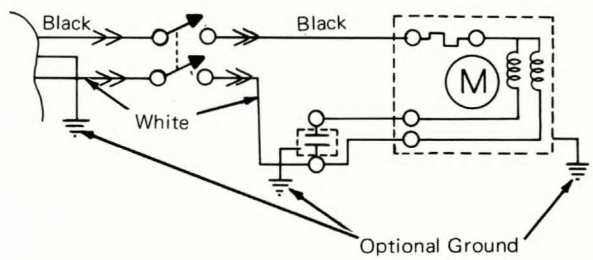


Figure 11 – Motor Assembly (Rear View)

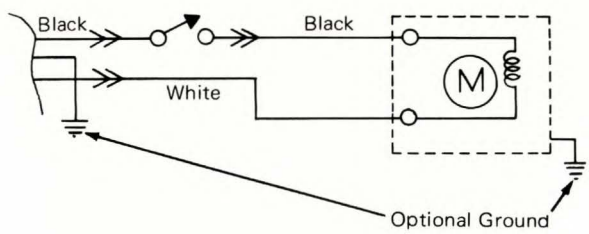
Double insulated machines can be identified by the motor switch mounted at the rear of the machine and a two-wire line cord. In order to convert the machine to a three-wire grounded system, the linecord must be replaced with a three-wire cord and the ground lead must be attached to the power frame at the cord clip screw. To complete the grounding, a wire must be connected to the motor housing and the motor mount bracket adjusting screw. If a capacitor type motor is used, the capacitor must also be grounded to the frame. This can be accomplished by removing the insulating material from between the capacitor and the frame of the machine. When a double insulated machine is converted in the field, it will no longer be considered as double insulated. (Fig. 12)



Double Insulated Shaded Pole Motor Diagram



Double Insulated Capacitor – Start Motor Diagram



Non Double Insulated Shaded Pole Motor Diagram

Figure 12 – Motor Wiring Diagrams

In the early production machines, a capacitor-start induction type motor is used. A three mfd. capacitor, in the starting winding circuit, provides a starting torque for the motor and controls the direction of rotation. The capacitor also remains in the circuit while the motor is running. The capacitor is mounted in a vertical position by a bracket at the rear corner of the machine. (Fig. 13)

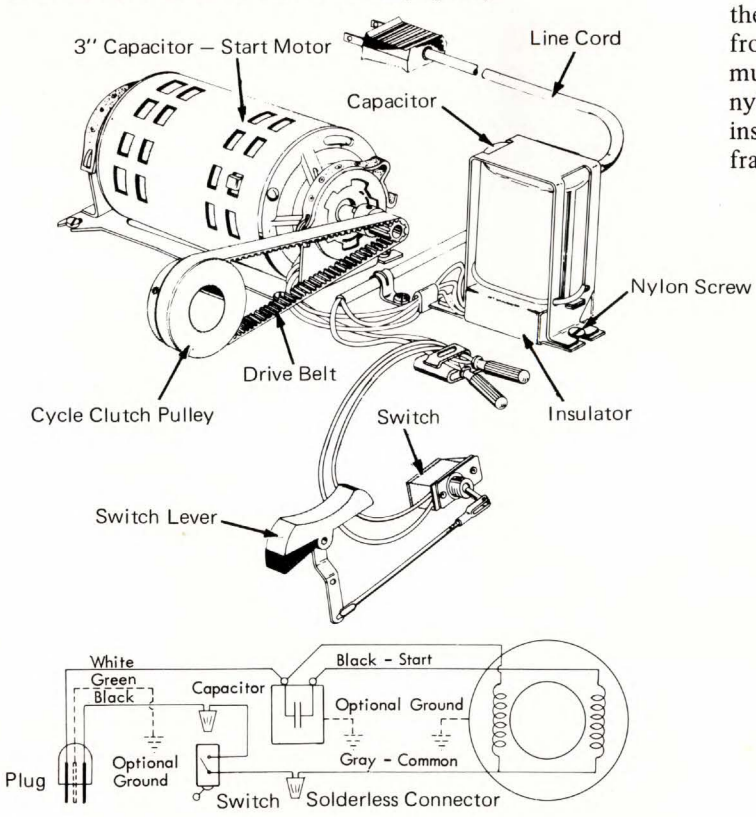


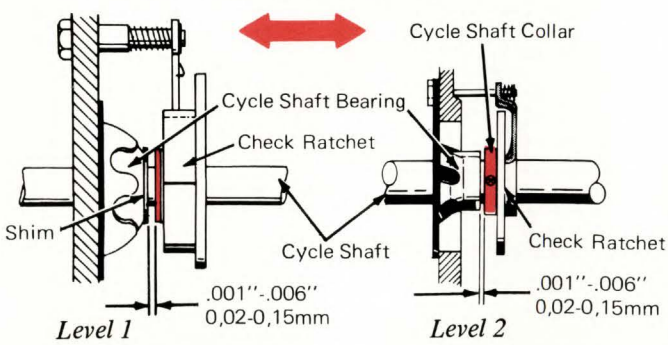
Figure 13 – Early Capacitor – Start Motor

In ungrounded systems, the capacitor is isolated from the power frame by a fiber insulator and nylon mounting screws. The motor is insulated from the power frame by its rubber mounting. To convert an ungrounded system to a grounded one, three steps must be taken: (a) The two-wire line cord must be replaced with a three-wire cord and the ground lead must be attached to the power frame at the cord clip; (b) A short jumper wire must be connected from the motor to the power frame; (c) The capacitor must be grounded to the power frame by replacing the nylon mounting screws with metal ones and removing the insulating material from between the capacitor and the frame of the machine.

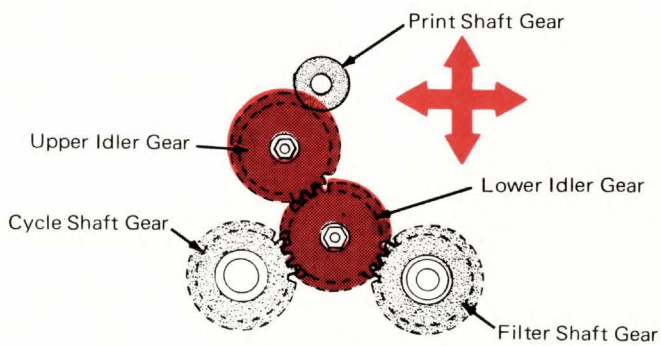
DRIVE MECHANISM ADJUSTMENTS

1. *Cycle Shaft End Play* – Shim the level 1 cycle shaft and adjust the collar on the level 2 cycle shaft to obtain .001"-.006" end play of the cycle shaft. The shims are placed between the left hand bearing and the check ratchet. The shims are available in various thicknesses and are coded by shape as described in the Parts Catalog.

   CAUTION: The slight end play of the cycle shaft ensures that it will rotate freely. Excessive play could allow a coil of the cycle clutch spring to wedge between the two hub members of the clutch causing a machine lockup.



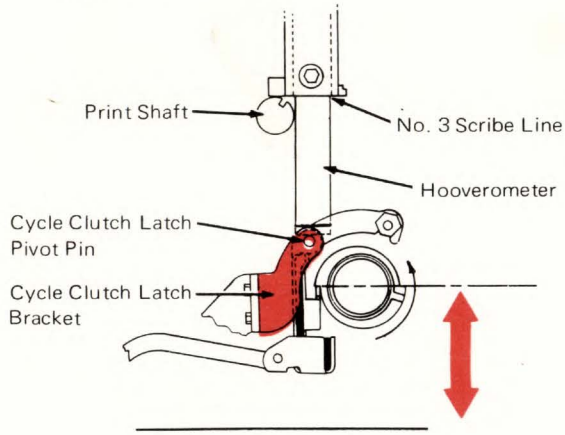
2. *Gear Train Backlash* – Adjust the idler gear studs so minimum backlash is present between mating gears. The mechanism must be free of binds throughout 360 deg. rotation of the gears. Minimum backlash is necessary to prevent erratic operation of the drive train and to ensure minimum overthrow of the driven shafts. The lower idler gear must be adjusted first because the upper idler gear is adjusted to the final position of the lower gear.



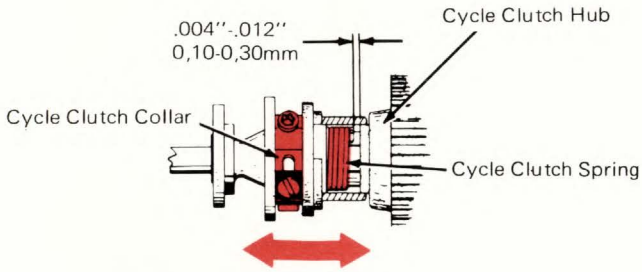
3. *Cycle Clutch Latch Bracket* – Adjust the bracket vertically so the Hooverometer, set on the No. 3 scribe line, just spans the distance between the print shaft and the cycle clutch latch pivot pin.

If the bracket were adjusted too low, the steps would be at an angle to the line of motion of the cycle clutch latch. The latch would have difficulty in moving forward to release the clutch sleeve, and a slow, hesitant operation would result. With the bracket too high, the force of stopping the cycle shaft through the cycle clutch sleeve would tend to cam the latch forward. A repeat cycle operation could result.

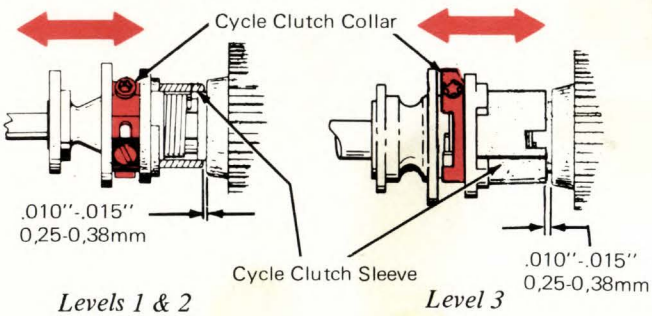
NOTE: Recheck the cycle clutch latch restoring adjustment (No. 5, Page 16) after changing this adjustment.



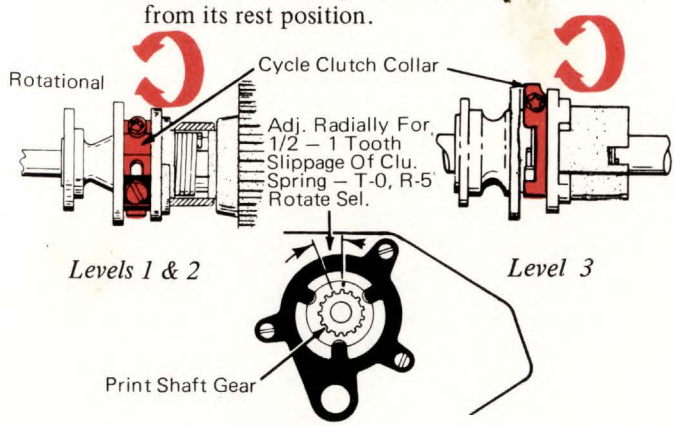
4. *Cycle Clutch* – The cycle clutch must be adjusted to satisfy the following conditions:
   a. Loosen the collar and position the spring left to right so the right end of the spring will clear the face of the cycle clutch pulley by .004"-.012".



   b. Position the collar left to right so the sleeve will have .010"-.015" end play.

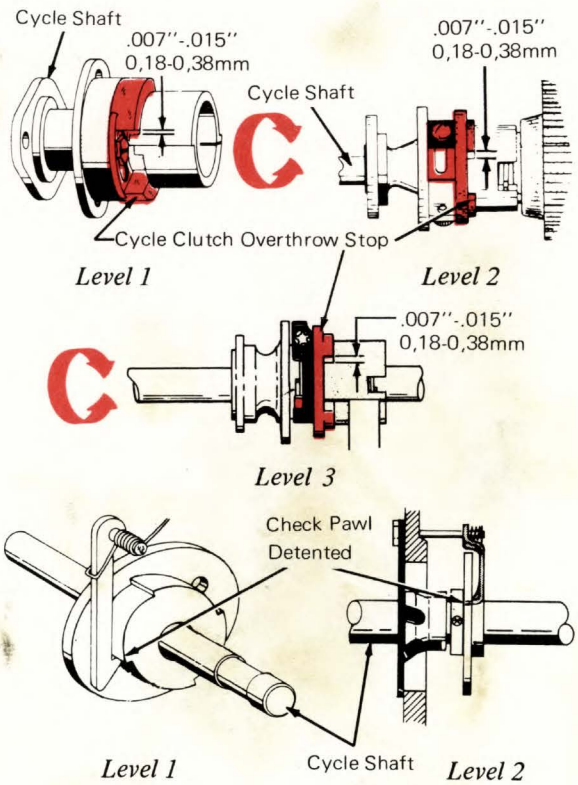


   c. When a zero tilt, negative five rotate character is hand cycled, adjust the collar and spring rotationally so the cycle clutch spring will begin to slip when the print shaft is 1/2 – 1 tooth from its rest position.


Rotational
Cycle Clutch Collar
Adj. Radially For 1/2 – 1 Tooth Slippage Of Clu. Spring – T-0, R-5 Rotate Sel.
Levels 1 & 2
Level 3
Print Shaft Gear

   d. Position the overthrow stop so it will allow the cycle shaft to overthrow its latched position by .007"-.015".

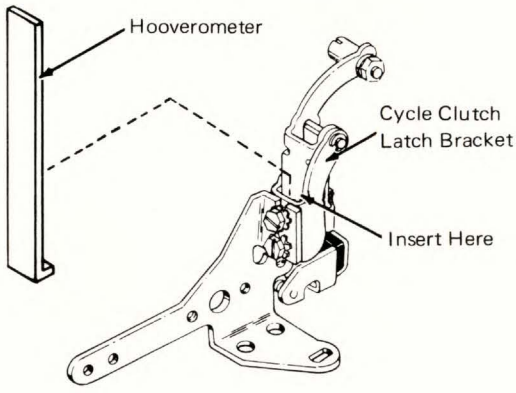
This adjustment on Level 3 machines must be made with the cycle clutch tripped; then checked with the machine at rest, to prevent loss of the cycle clutch spring radial adjustment.



An easy method to obtain this adjustment with "power on" is as follows:

a. Leave the right hand dust shield in place while performing this "power on" adjustment. This will eliminate the danger of the bristo wrench being thrown out of the machine due to the possibility of it contacting the torque limiter hub. Rotation of the cycle clutch pulley and drive belt does not constitute a hazard as there are no exposed projections which could propel the bristo wrench out of the machine.

b. Insert the "L" shaped foot of the Hooverometer into the cycle clutch latch link to prevent accidental cycling of the machine while performing the "power on" adjustment of the cycle clutch.



c. Turn machine on, position the cycle clutch collar screw up, then position the carrier into the RH margin to prevent cycling of the cycle shaft.

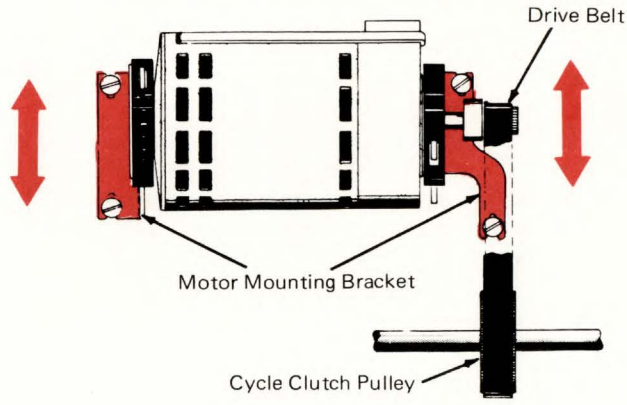
d. Loosen the cycle clutch clamp screw and overthrow stop screws then advance print shaft (top to rear). Caution: Do not trip the cycle clutch with the bristo wrench in the clamp screw.

e. At this time check the lateral position of the cycle clutch spring. Expand the cycle clutch spring by pushing the LH side of the spring with a spring hook. The lateral position of the spring can be changed by pushing left or right for proper adjustment with the cycle pulley.

f. Rotate the print shaft a complete cycle (top to rear) until the cycle shaft check pawl drops in. Back the cycle shaft up against the check pawl.

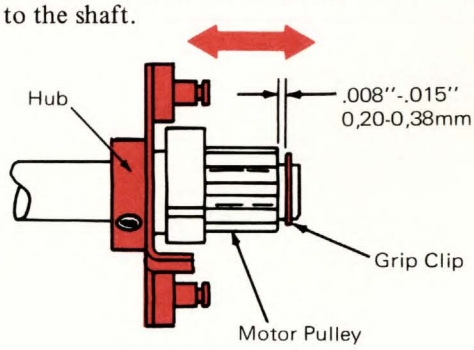
g. Position the overthrow stop for .007"-.015" clearance and tighten the clamp screw. This will give approximately 1/2 tooth of motion to "unwrap" the spring in its rest position. Observe this motion at the print shaft gear by hand cycling a zero tilt, negative-five character with the power off.

5. *Drive Belt* – Adjust the motor mounting brackets front to rear to obtain a minimum amount of belt noise. The belt must not be loose enough to allow the belt to jump cogs on the motor pulley. Check by operating the carrier return mechanism and holding the carrier while simultaneously operating the shift mechanism. This loads the motor to a point where failure will be most probable.

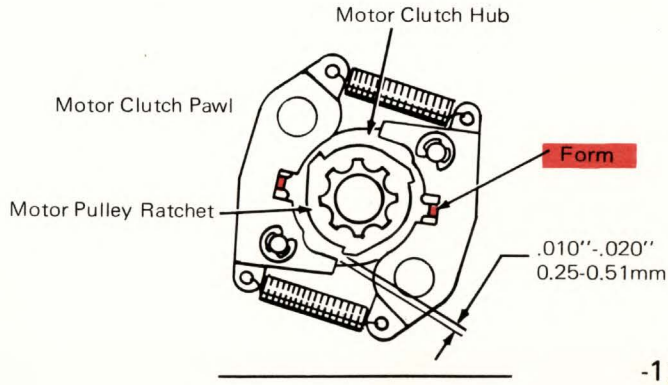


6. *Motor Pulley* – Adjust the hub and grip clip left to right so the belt rides fully on both pulleys. Maintain .008"-.015" pulley end play with the grip clip.

NOTE: Make certain the plastic bushing is installed to prevent the motor pulley from "freezing" to the shaft.



7. *Motor Clutch Pawl Stops* – Form the lug on the clutch hub to obtain a clearance of .010"-.020" between the tip of a clutch pawl and the pulley ratchet when the pulley is manually rotated.



The keyboard is compact and is detachable as a unit from the rest of the machine. In this section, we will discuss how the keyboard controls the selection latches to determine the specific character that will print, and the tripping of the cycle clutch.

The keylevers pivot on a fulcrum rod at the rear. A guide comb limits the travel of the keylevers in the front.(Fig. 1)

Keylever tension is supplied by flat leaf spring fingers under the front of the keylevers. The forward end of each spring finger is cupped so that the spring will maintain its position under the keylever. Different spring tension is supplied to the four rows of letter keylevers by auxiliary leaf springs under the keylever springs. The auxiliary spring fingers vary in length to offset leverage difference between the four rows of keylevers. This variation in spring tension permits a uniform operating force requirement for all keylevers.

Attached to each keylever by a shoulder rivet, is a keylever pawl. This pawl is spring loaded and is in a position to strike the top of an interposer.

Each character keylever has an interposer located just below it. The interposer is used to select the amount of tilt and rotate needed to bring the desired character to the printing point. The interposer pivots about a large fulcrum rod at the front and is spring loaded up at the rear. The front and rear of the interposer is positioned laterally by a guide comb. The interposers are allowed to move vertically in the rear guide comb as well as front to rear.

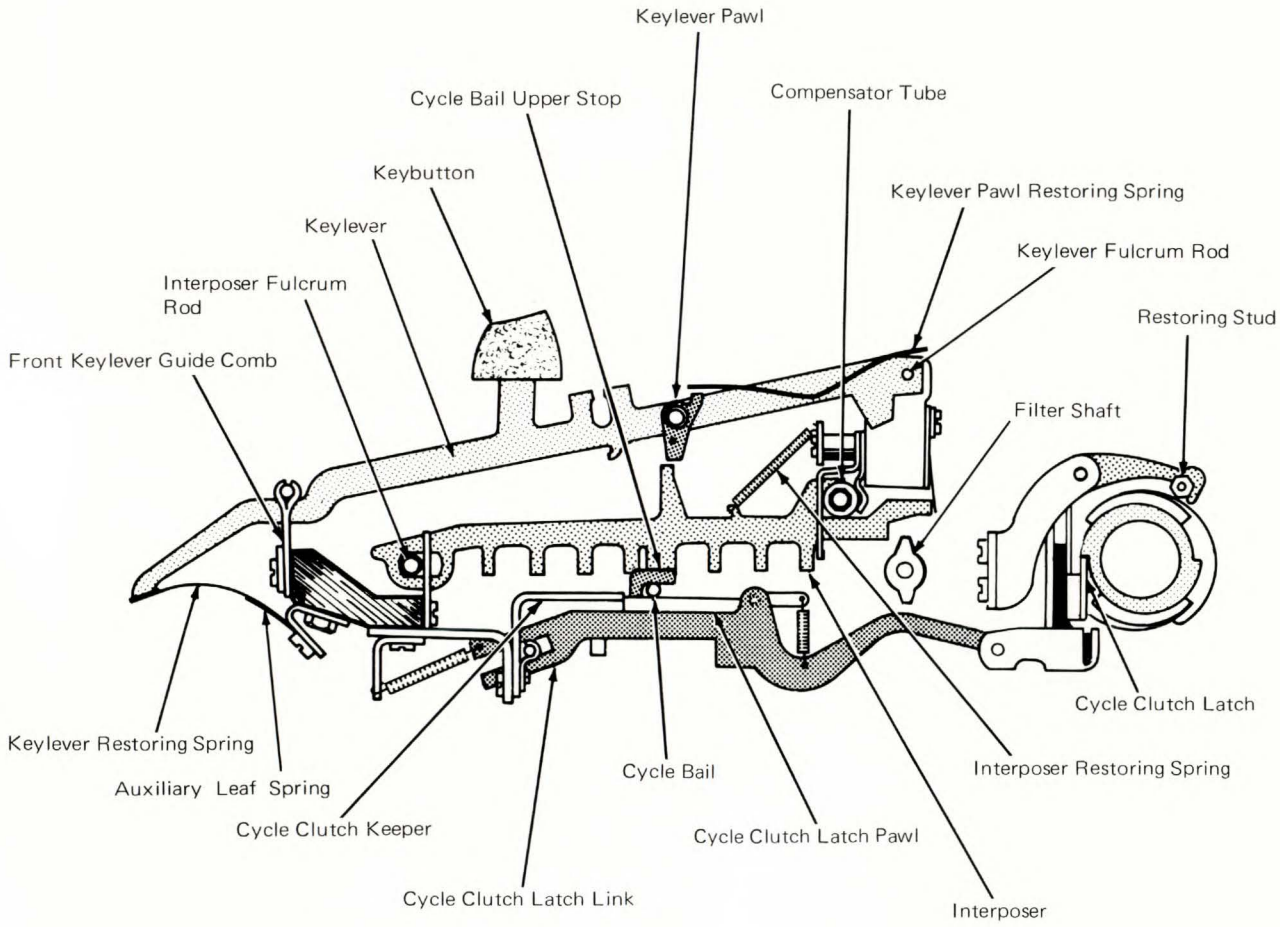


Figure 1 – Keyboard

The interposers have several lugs extending from them. There are positions for eight lugs on the bottom. Seven of these lugs are used for selection. The absence or presence of these lugs will determine which of the selector bails will be operated. No two interposers are alike. The rear most lug is used for special applications of the machine. The wide lug in the middle is common to all interposers. Its purpose is to release the cycle clutch whenever a keylever is depressed. Mounted directly below this lug is a cycle bail that pivots vertically. Downward movement of the interposer forces the cycle bail to release the cycle clutch latch pawl. (Fig. 2)

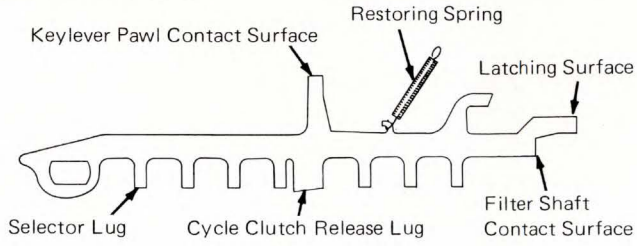


Figure 2 – Interposer

To assure the interposer will remain depressed long enough to operate the character selection mechanism, a spring latch is employed. The interposer latch is a flat leaf spring mounted to the rear keylever guide comb in a position to snap forward trapping the interposer down when it is depressed. (Fig. 3)

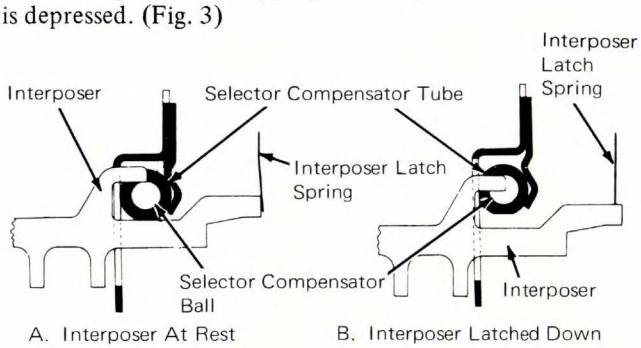


Figure 3 – Interposer Latch and Selector Compensator

A compensator tube is used to prevent the latching of more than one interposer down at a time. Each interposer has a lug at the top of the interposer that intersects the compensator tube. The compensator tube contains closely spaced steel balls. When an interposer is down, the steel balls shift in the compensator tube to block the downward movement of any other interposer. (Fig. 4)

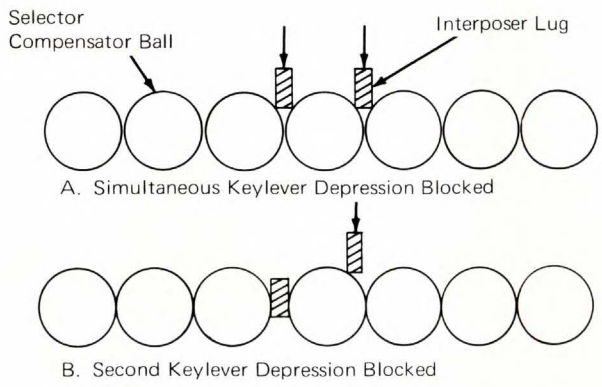


Figure 4 – Selector Compensator Action

An adjustable stop, located at each end of the compensator tube, keeps the steel balls centered between the interposers. The balls are thus prevented from shifting too far to the left or right. If the balls were allowed to move too far under the interposer lugs, they would partially block the depression of an interposer and result in a stiff keyboard. (Fig. 5)

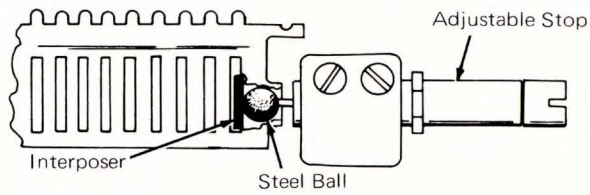


Figure 5 – Compensator Tube

Located at the left end of the selector bails are six latch interposers. Each latch interposer has a lug that extends up directly in front of the selector bail. As the selector bail is driven forward, the latch interposer is carried with it. An extension spring at the bottom of each latch interposer loads the interposer and its selector bail to the rear. (Fig. 6)

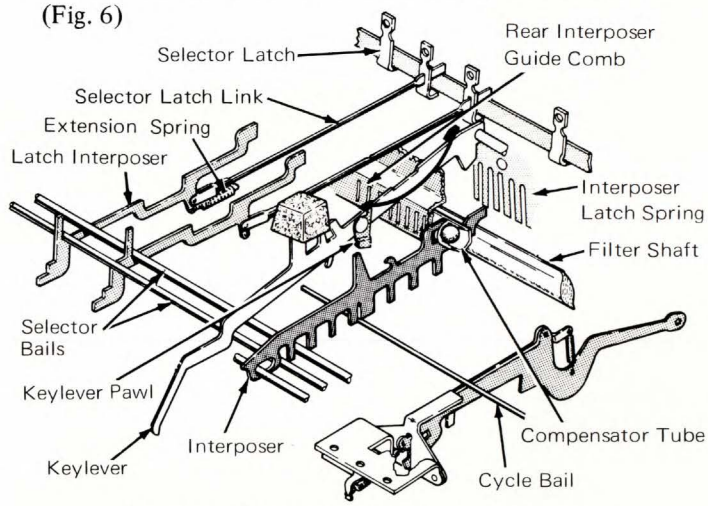


Figure 6 – Keyboard Selection Mechanism

An adjustable link connects each latch interposer to one of the selector latches of the selection mechanism. When a latch interposer is moved forward, the selector latch connected to that interposer is also pulled forward to prevent it from being operated downward by the latch bail.

A filter shaft is mounted just to the rear of the interposers. Once the interposer is in the latched position, rotation of the filter shaft will drive the latched interposer forward. The interposer lugs will then operate its corresponding selector bail. The interposer motion is sufficient to remove the interposer from beneath the interposer latch spring. This allows the interposer spring to restore the interposer to its rest position. (Fig. 7)

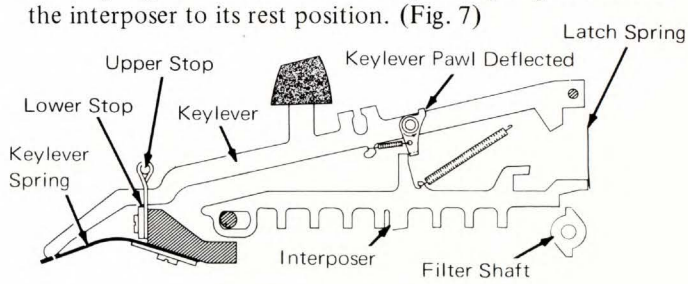


Figure 7 – Keylever Held Depressed

Although not a part of the keyboard section, the cycle clutch latch is directly related to the keyboard mechanism. Depression of a keylever will allow the cycle clutch to operate. (Fig. 8)

The cycle clutch latch pivots from the top of a bracket that mounts at the front of the power frame. The latch is held in a position to engage the cycle clutch sleeve by a cycle clutch latch pawl and link assembly that extends forward from the cycle clutch latch. The cycle clutch latch pawl pivots on the cycle clutch latch link. The cycle clutch latch pawl engages the cycle clutch keeper to prevent the cycle clutch latch from being pulled forward.

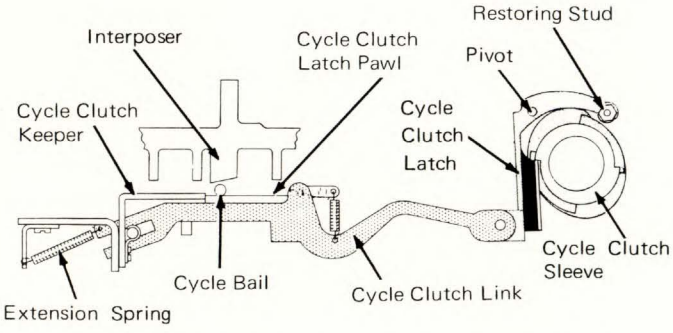


Figure 8 – Cycle Clutch Latch Mechanism (At Rest)

When the keylever is depressed, the interposer beneath the keylever forces the cycle bail to pivot downward. The cycle bail moves the cycle clutch latch pawl downward disengaging it from the keeper. An extension spring at the front of the link is allowed to snap the link and cycle clutch latch forward disengaging the latch from the cycle clutch sleeve. This allows the cycle clutch spring to tighten and begin a cycle operation.

A nylon cam attached to the cycle clutch clamp restores the cycle clutch latch beneath the sleeve. A horizontal extension at the top of the cycle clutch latch has a small adjustable stud mounted on it which rides the cam during a restoring operation. When the machine is at rest, the low point of the restoring cam is directly below the stud. When the cycle clutch latch swings forward, the stud on the extension drops down onto the restoring cam. The cam rotates toward its high point and forces the stud on the extension up, swinging the cycle clutch latch to the rear into the path of the cycle clutch sleeve. The latch is restored far enough to the rear to permit the cycle clutch latch pawl to reset on its keeper. (Fig. 9)

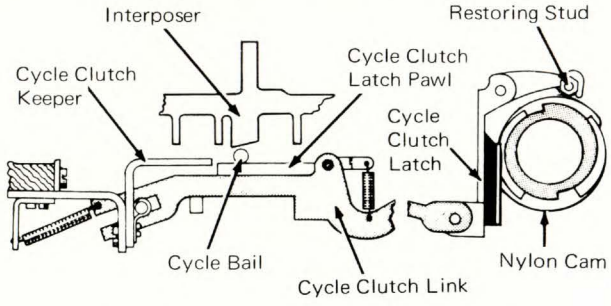


Figure 9 – Cycle Clutch Latch Restoring

A small lever, called the cycle bail damper, pivots at each side of the keyboard just above the cycle bail. The purpose of the dampers is to lightly retard the upward movement of the cycle bail so as to prevent the bail from bouncing as it reaches the upward limit. Without the dampers, the bail could have a tendency to bounce. (Fig. 10)

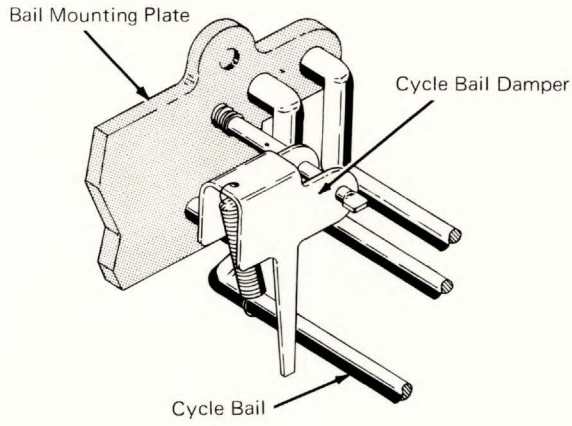


Figure 10 – Cycle Bail Damper

When the switch is in the off position, the keyboard must be locked to prevent the motor from having to start under a load and to prevent an unwanted operation the next time the switch is turned on. The switch lever operates the lockout bail into a position below an extension of the cycle clutch latch pawl when the switch lever is in the off position. To further assure against an interposer from latching down, a special bellcrank at the left side of the keyboard is rotated into the selector compensator tube by the lockout bail. This forces the steel balls to shift in the tube and block the downward movement of all interposers. When the switch is in the on position, the keyboard lock bellcrank is spring loaded out of the selector compensator tube. (Fig. 11)

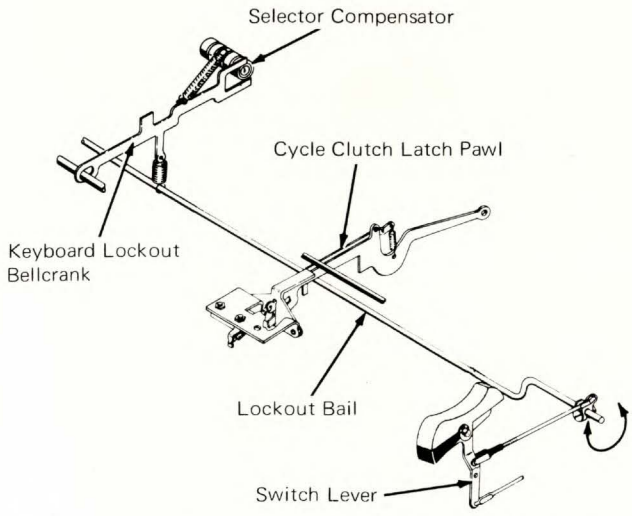
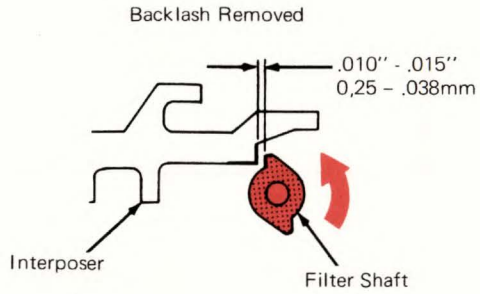


Figure 11 – Keyboard Lock Mechanism - ON Position

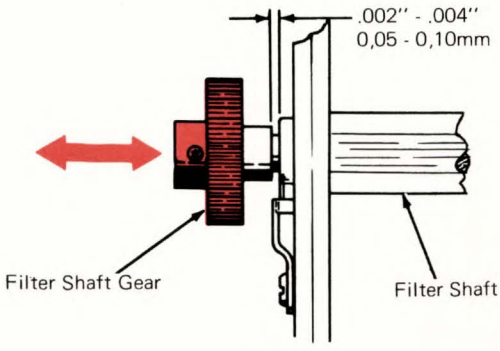
1. *Filter Shaft* – With the machine at rest and all gear train backlash removed in the forward direction, the working surface of the filter shaft should clear the rear of any latched interposer by .010" - .015". Loosen the filter shaft gear and adjust the filter shaft rotationally to meet this condition. Be sure to maintain .002" - .004" end play of the filter shaft within the left hand filter shaft bearing. This adjustment affects the spacebar lockout cam and the escapement cam timing.

   Insufficient clearance between the filter shaft and the interposers could allow the filter shaft to stop just under the rear of the interposers. The keyboard would then be inoperative, because the interposers could not be depressed.

   Excessive clearance would delay the operation of the interposers. The selector latches would not be pulled forward until after having been pulled down slightly by the latch bail. This would result in excessive wear and a noisy operation as the latches were snapped forward from under the bail.



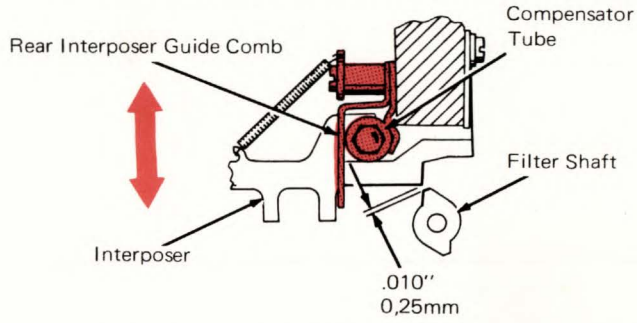
Side View



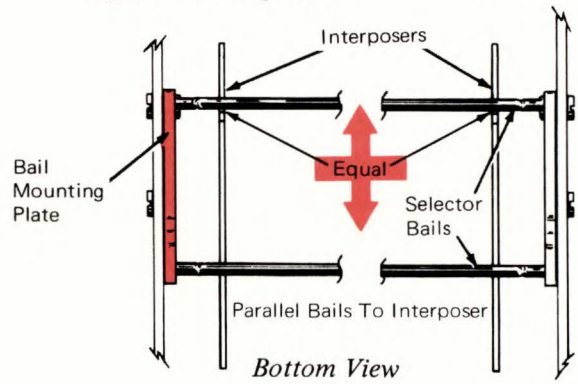
Front View

2. *Rear Interposer Guide Comb* – With the end interposer latched down, pull any other interposer down with a spring hook. The second interposer should clear the tip of the filter shaft by .010" as the filter shaft rotates under it. Check this at several points along the filter shaft. Loosen the four screws on the guide comb and move it vertically to satisfy this condition.

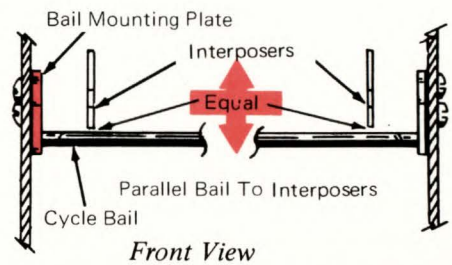
   NOTE: The selector compensator tube is mounted to the rear of the interposer guide comb by four clamps and must move vertically with the guide comb when the guide comb adjustment is made. Be sure to loosen the guide comb mounting screws before attempting to move the guide comb. DO NOT HAMMER THE GUIDE COMB INTO POSITION AS THIS CAN CAUSE THE COMPENSATOR TUBE TO SHIFT WITH RESPECT TO THE GUIDE COMB. The vertical position of the tube on the guide comb is set with respect to the stop strap riveted along the bottom of the guide comb and should not be disturbed.



3. *Bail Mounting Plate* – Position the left hand bail mounting plate to satisfy the following conditions. The selector bails should be parallel front to rear with the lugs on the interposers. At the same time, the cycle bail must be parallel vertically with the lugs on the interposers.

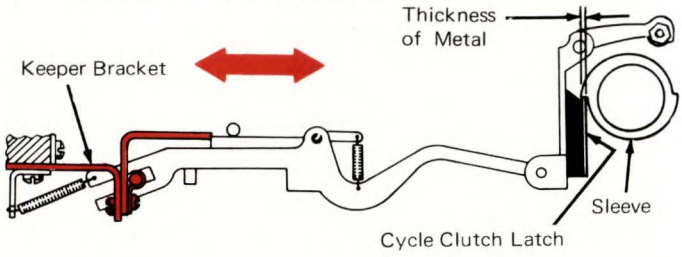


Bottom View

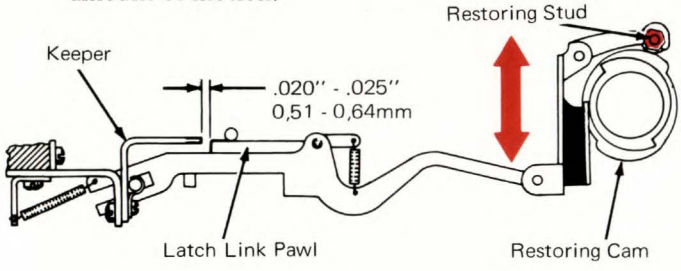


Front View

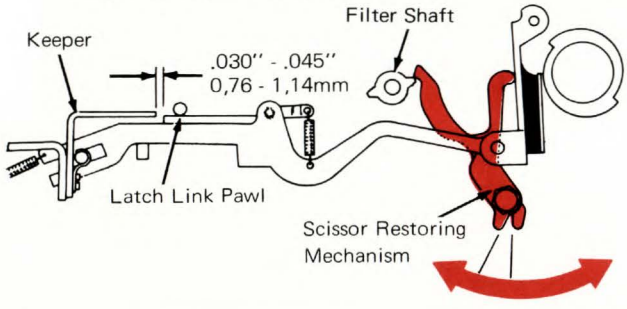
4. *Keeper Bracket* – With the machine at rest, the cycle clutch latch should engage the sleeve by the thickness of its metal. Adjust the keeper bracket front to rear to obtain this condition.



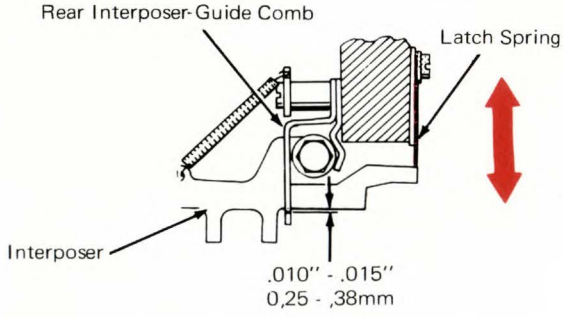
5. *Cycle Clutch Latch Restoring* – Adjust the restoring stud vertically so, as the machine is hand cycled, the latch link pawl is pulled .020" - .025" to the rear of the keeper before it restores. Check this clearance on both lobes of the restoring cam and adjust the stud on the lobe providing the least amount of motion.



Machines equipped with a scissor type restoring mechanism operating from the filter shaft, must be adjusted so the latch link pawl overthrows the keeper by .030" - .045".



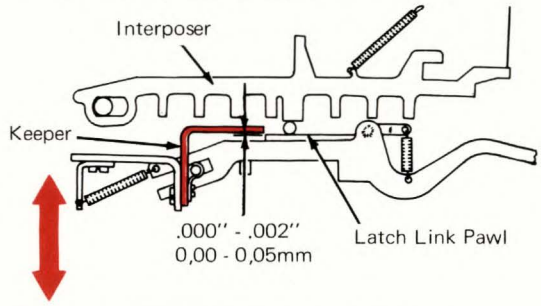
6. *Interposer Latch Springs* – Adjust the right interposer latch spring vertically so with the +/= interposer latched down, there will be .010"-.015" travel remaining.



7. *Cycle Clutch Keeper* – With the +/= interposer latched down, adjust the keeper vertically to obtain .000"-.002" clearance between the cycle clutch latch link pawl and the lower side of the keeper. Then, position the left and right interposer latch springs vertically to maintain the .000"-.002" keeper clearance with various interposers latched down.

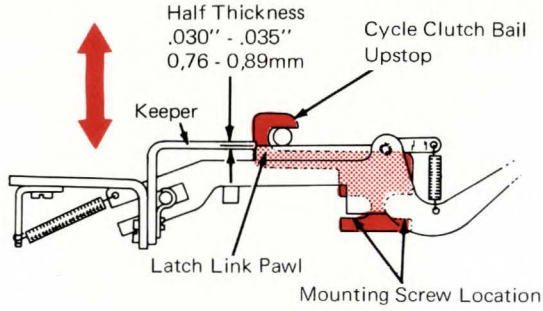
NOTE: This clearance should be maintained on the low side of the adjustments. Too much clearance can cause an erroneous selection because of flicking action on the keylevers causing the cycle clutch to be released without latching an interposer down. As a result, the filter shaft will not drive an interposer forward and the hyphen or underscore will be printed.

Insufficient clearance does not ensure that the clutch will be released when an interposer is latched down. If an interposer is latched down without releasing the cycle clutch, the keyboard will be locked because the interposer will remain in the compensator tube.

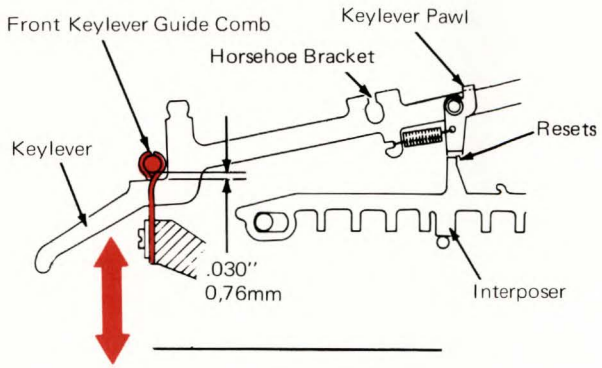


8. *Cycle Bail Upstop* – Adjust the cycle clutch bail upstop vertically so the cycle clutch latch link pawl engages the cycle clutch keeper by half its thickness with the machine at rest. The bail stop is mounted with two nuts and two screws. These nuts and screws also control the position of the character interrupter bail plate. In order to adjust the cycle clutch bail stop, loosen both nuts and only the front screw. Do not loosen the rear screw.

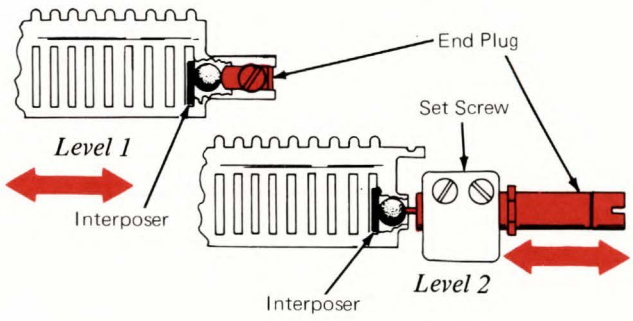
Insufficient bite will increase the possibility of a repeat cycle because positive latching is not ensured. Excessive bite will affect the touch of the keyboard because the latch pawl must be moved farther in order to trip the cycle clutch.



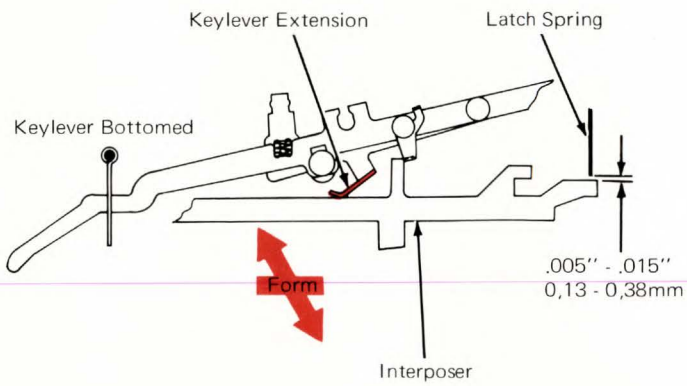
9. *Front Keylever Guide Comb* – With the power on, depress and slowly release keybuttons on the right, left and middle of the keyboard. There should be .030" clearance between the keylever and the top of the slot in the guide comb as the keylever pawl resets above the interposer. Adjust the front keylever guide comb vertically to satisfy this condition. Individual keylevers that do not conform to the majority may be formed at the horseshoe bracket.



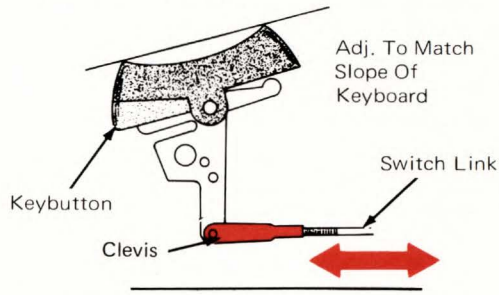
10. *Compensator Tube* – Adjust the left and right end plugs for best possible touch. There should be no hesitation as you depress the keylevers.



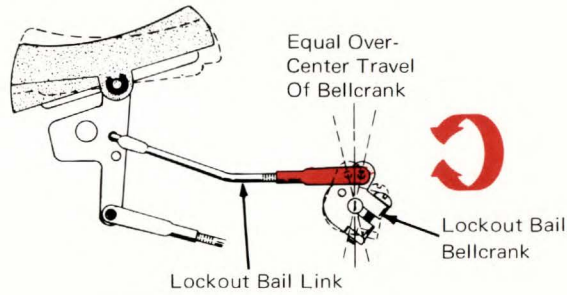
11. *Typamatic Keylever* – Form the keylever extension to cause the interposer to travel .005" - .015" beyond the latched position with the keylever bottomed in the repeat position.



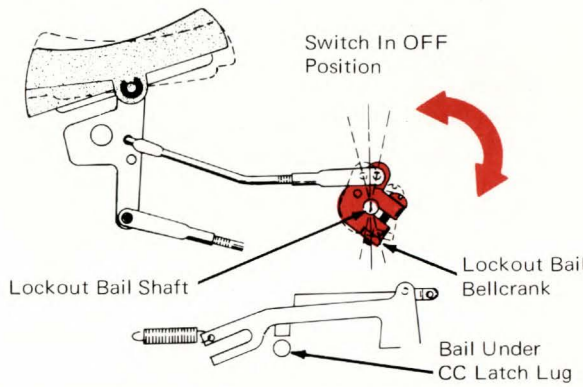
12. *Switch Link* – Adjust the switch link clevis so the on-off keybutton matches the slope of the keyboard in the off position.



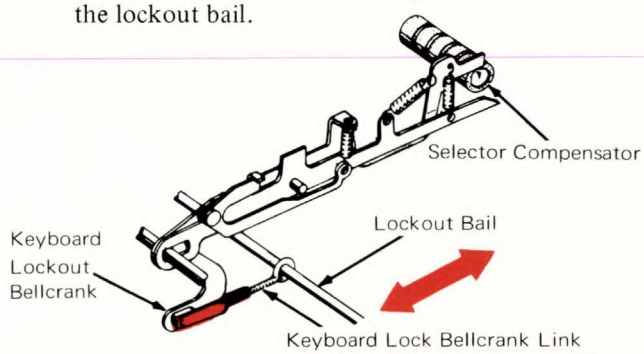
13. *Lockout Bail Link* – Adjust the keyboard lockout bail link clevis to obtain equal motion over center of the lockout bail bellcrank.



14. *Lockout Bail Bellcrank* – Adjust the lockout bail bellcrank rotationally on the lockout bail shaft so the lockout bail is positioned beneath the lug on the cycle clutch latch pawl when the switch is in the off position.



15. *Keyboard Lock Bellcrank Link* – Machines equipped with this link should be adjusted so the bellcrank is fully bottomed in the selector compensator tube without choking off the action of the lockout bail.



SHIFT OPERATIONAL THEORY

The purpose of the shift mechanism is to rotate the typehead 180 deg. in the counter clockwise direction. This action places the upper case hemisphere of the typehead near the platen for typing capital letters. Each upper case character is in the same tilt band as its lower case counterpart but 180 deg. from it.

The shift mechanism consists of a shift arm, shift cam, spring clutch, clutch control mechanism and interlocks.

The power to operate the shift mechanism is taken from the right hand end of the operational shaft. (Fig. 1)

Two keybuttons, one at each front corner of the keyboard, can be used to actuate the shift mechanism. A bail is used to tie the two keylevers together. The left hand keylever has a lock mechanism attached to it to enable the operator to lock the keybutton down in the upper case position. The shift lock may be released by depressing and releasing either shift keybutton.

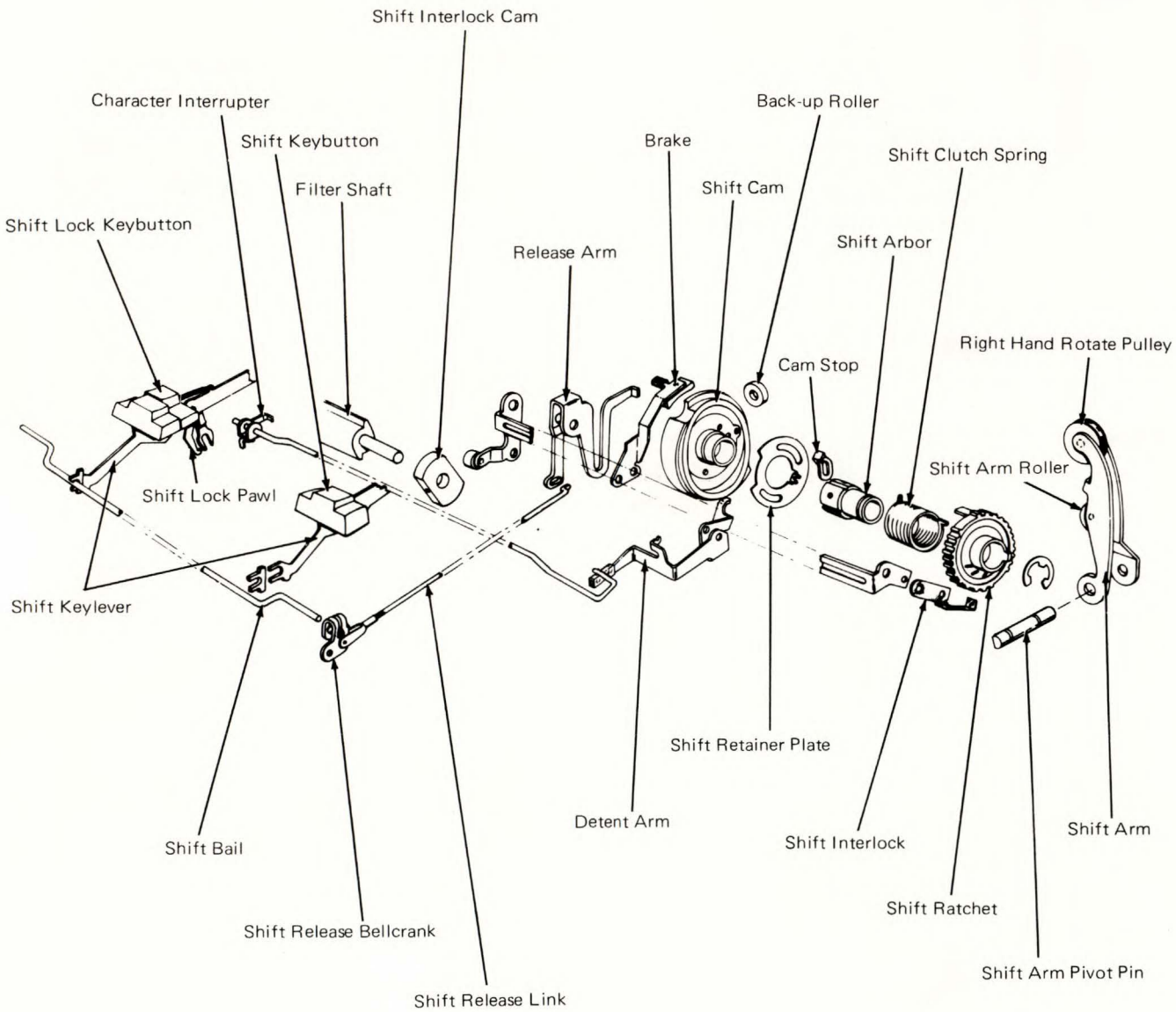
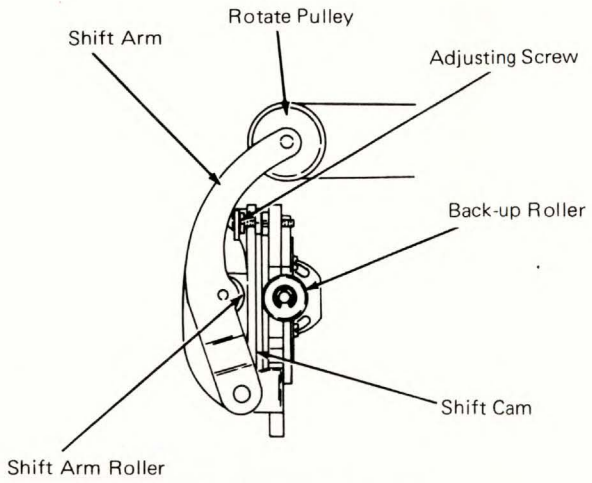


Figure 1 – Shift Mechanism

The right hand rotate pulley is fastened to the top of the shift arm. The shift arm pivots left to right about a pin at the bottom. Mid point on the shift arm is a roller that rides the surface of the shift cam. In the lower case position, the shift arm rests against the head of an adjustable screw on the side of the power frame. (Fig. 2)

The shift cam is a disc shaped cam that has the lobe on the right hand side of the cam rather than on the perimeter. A roller is mounted in a fixed position to the left of the shift cam, directly opposite the roller on the shift arm, and serves as a backup roller for the cam. When the cam is operated 180 deg., the high point is encountered and forces the shift arm to the right into the upper case position.



(Rear View)

Figure 2 – Shift Plate Assembly

The shift cam rotates only during shift operation and is controlled by a spring clutch. One end of the spring clutch is anchored to the shift cam by an adjustable retainer plate. The other end of the shift clutch spring is mounted to the shift ratchet. (Fig. 3)

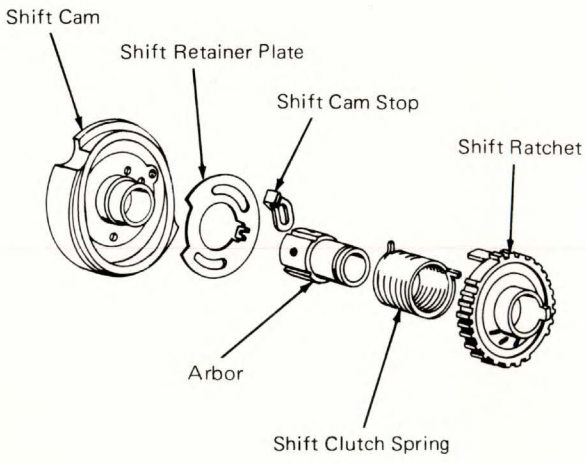


Figure 3 – Shift Clutch

The shift ratchet has two lugs protruding to the left side 180 deg. apart. One lug is nearer the center of the ratchet than the other lug. The shift clutch release arm, pivoted just in front of the cam, blocks the lugs to stop the rotation of the ratchet. The position of the shift release arm determines which lug will be stopped. The shift release arm is positioned by a link connected between the shift clutch release arm and a bellcrank attached to the shift bail. When the keylevers are at rest, the release arm is in a position to contact the inner lug of the shift ratchet. Depression of the keylever causes the clutch release arm to rise out of the path of the inner lug into the path of the outer lug. This allows the spring clutch to tighten around the shift arbor and drive the shift cam until the outer lug of the shift ratchet is encountered. (Fig. 4)

The overthrow of the shift cam is controlled by an adjustable stop attached to the cam and operates against the inner lug of the shift ratchet. Since the relationship between the inner lug and the shift cam stop remains constant for both upper and lower case, overthrow can be controlled whenever the ratchet is stopped by either lug on the shift ratchet.

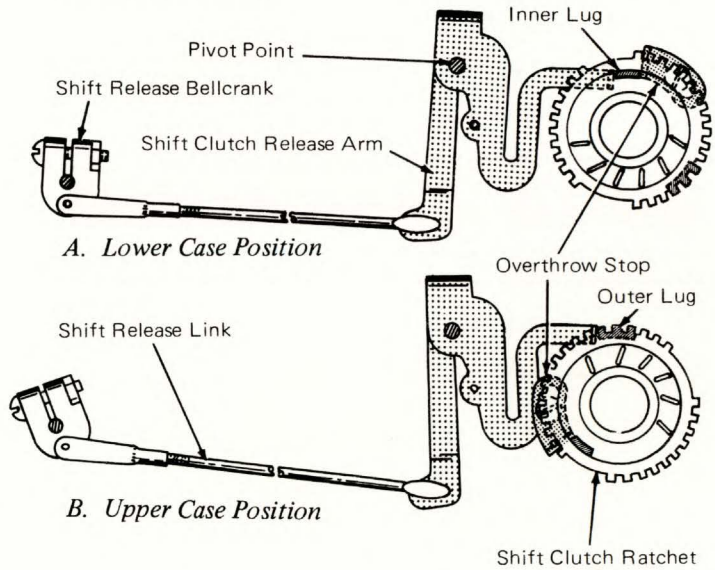


Figure 4 – Shift Clutch Release Mechanism

Shift cam overthrow is a greater problem in returning the machine to lower case than in shifting to upper case. This is due to the acceleration received from the pressure of the shift arm roller against the receding surface of the shift cam. To prevent excessive noise and possible parts breakage, a raised braking surface on the shift cam contacts a nylon shoe mounted to a heavy spring when returning to lower case and prevents acceleration of the shift cam. (Fig. 5)

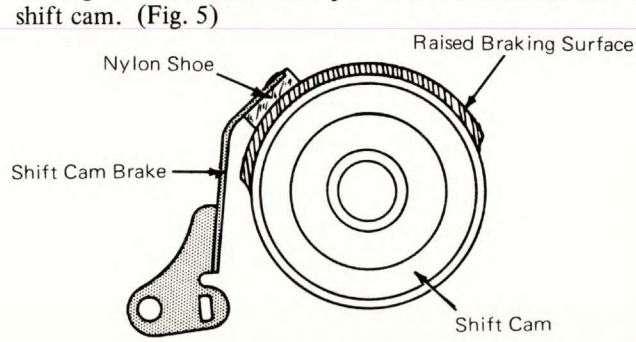


Figure 5 – Shift Cam Brake

Pivoted on a stud in front of the shift cam is the shift detent arm. The shift detent arm detents the shift cam in position and operates the character interrupter mechanism. The character interrupter mechanism prevents the operation of a character anytime the shift is in process. The character interrupter pawl is rotated into the path of the cycle clutch latch link and prevents the release of the cycle clutch. This interlocking action does not prevent the depression of a keylever or an interposer. The interposer is latched down into storage. When the shift operation is completed, the detent enters a recess in the cam removing the character interrupter pawl from in front of the cycle clutch latch link. (Fig. 6)

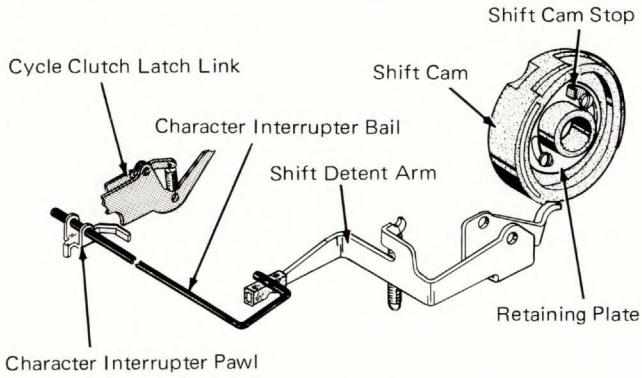
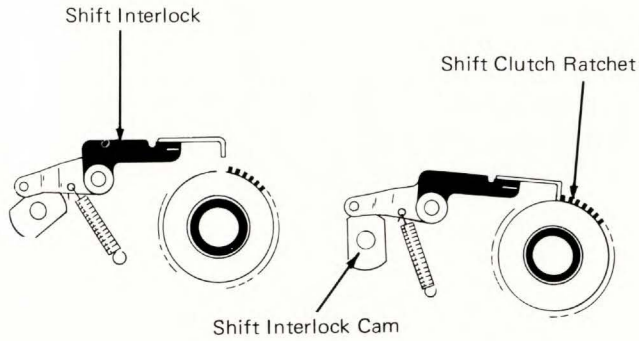


Figure 6 – Shift Arm and Detent

If the shift mechanism is tripped during a print character cycle, the shift interlock prevents the shift from operating until the character cycle is completed. The shift interlock operates from a cam mounted to the filter shaft. Each time the filter shaft turns, the shift interlock is positioned into the shift clutch ratchet to prevent a shift operation. (Fig. 7)



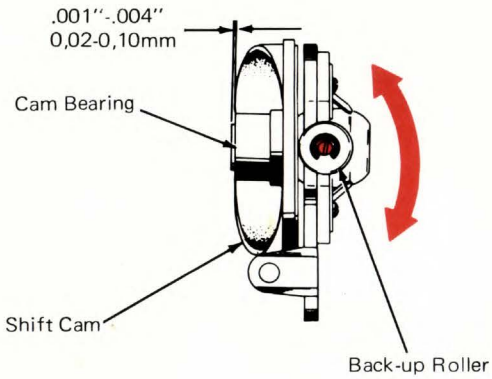
A. Rest Position *B. Active Position*

Figure 7 – Shift Interlock

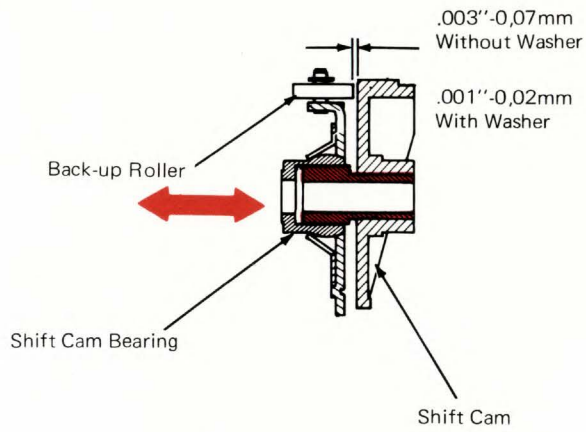
SHIFT ADJUSTMENTS

1. *Shift Cam Backup Roller (Early Machines)* – Adjust the backup roller eccentric left to right so .001" - .004" of the cam bearing extends beyond the cam. The eccentric should be kept in the bottom half of its orbit.

   CAUTION: Any change in the rest position of the backup roller, directly affects the typehead homing and the shift arm motion adjustments. Be sure to recheck these adjustments.

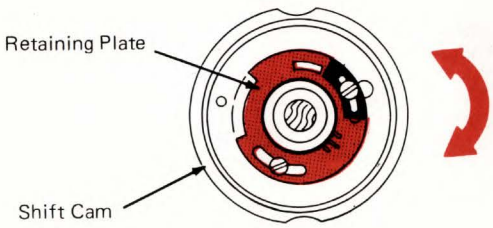


2. *Shift Cam Bearing* – Adjust the shift cam bearing left to right to obtain .003" without the washer or .001" with the washer between the shift cam and the shift cam backup roller. Machines requiring this adjustment can be identified by a set screw on the left hand side of the shift bearing plate.

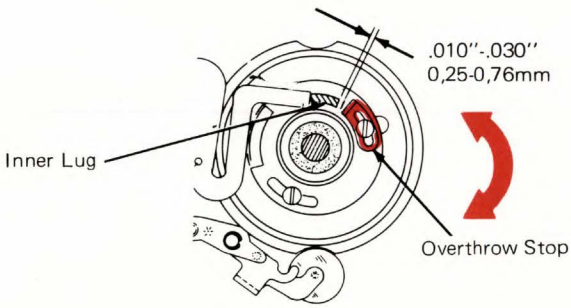


Note: Machines above S/N 7X1-5805429; 7X3-5277541; 7X5-5623384 do not have adjustments 1 & 2.

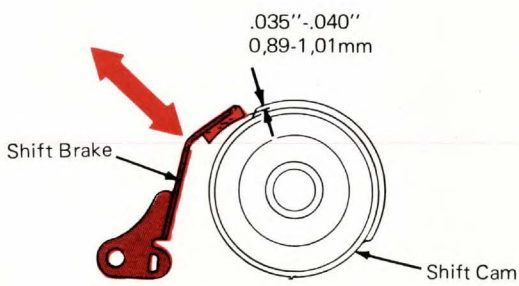
3. *Shift Spring Clutch Retaining Plate* – With the machine off and the shift cam in the lower case rest position, adjust the retaining plate rotationally so the ratchet will rotate one tooth when released on machines with a metal cam and one and one half to two teeth rotation on machines with a plastic cam.



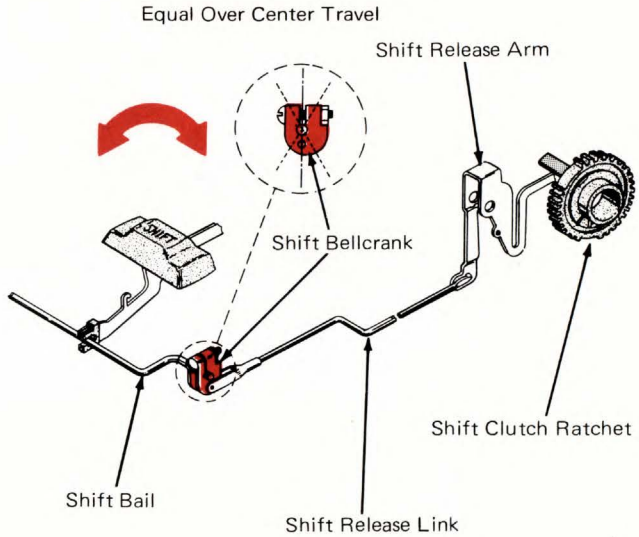
4. *Shift Overthrow Stop* – With all parts at rest, adjust the shift overthrow stop to obtain .010" - .030" clearance between the stop and the inner lug of the shift ratchet



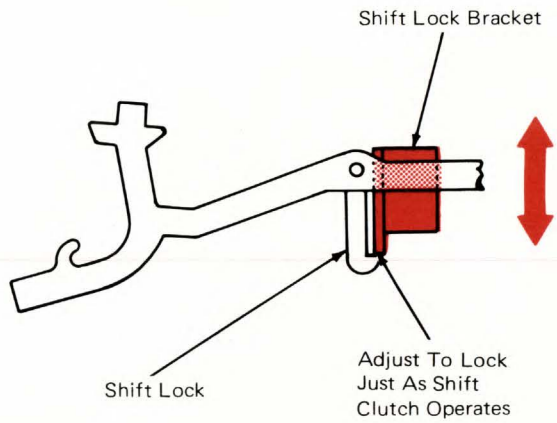
5. *Shift Brake* – Adjust the shift brake to obtain .035" - .040" rise as the brake contacts the working surface of the shift cam.



6. *Shift Release* – Position the shift bellcrank rotationally on the shift bail to have the same over-center travel in both directions. Adjust the shift release link so release occurs when the keylever is depressed two-thirds of the way down. As the keylever is allowed to restore from a fully depressed position, the shift should again operate when two-thirds travel of the keylever has been reached. A balance between the two releasing points ensures proper adjustment.

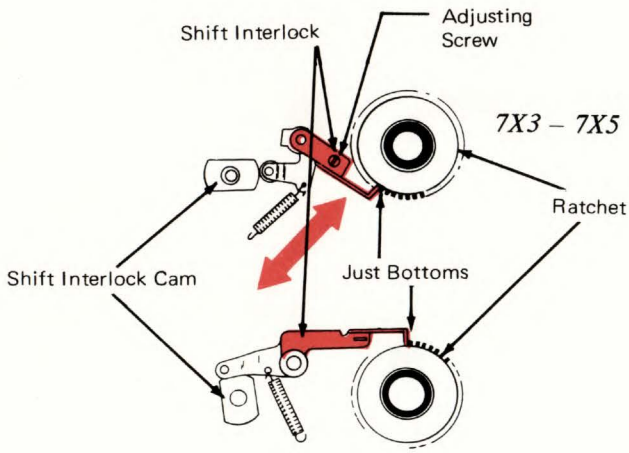


7. *Shift Lock* – Adjust the shift lock bracket vertically so the shift lock engages just as the shift operates or slightly afterward. The lock should not engage before the shift release occurs. The shift lock must be released easily by depressing either shift keybutton.



8. *Shift Interlock* – The shift interlock must be adjusted to satisfy the following conditions:

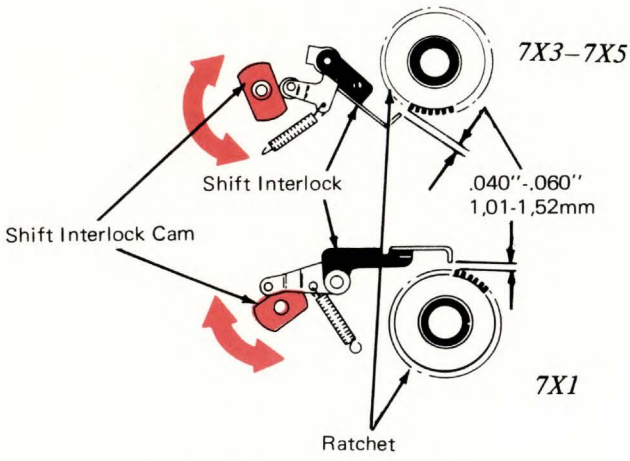
a. When the interlock follower is on the high point of the interlock cam, the tip of the interlock should just bottom between two teeth on the ratchet. Adjust the interlock by its adjusting screw on 7X3, 7X5 machines to satisfy this condition or form the interlock on 7X1 machines.



7X1

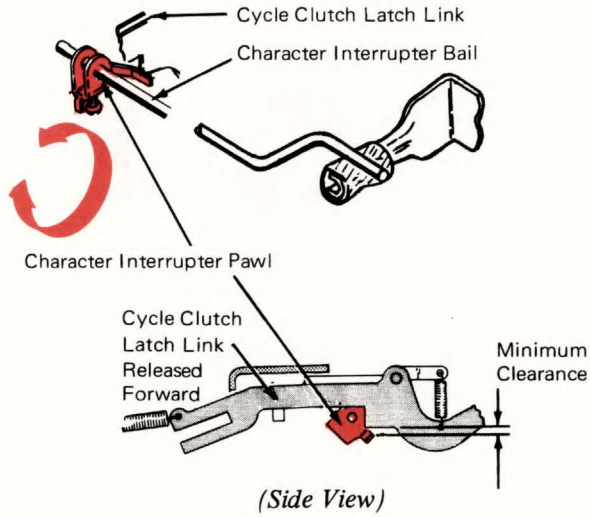
b. With the cycle clutch latched at rest and all backlash of the cycle shaft and filter shaft removed in the operating direction, adjust the cam until a clearance of .040" - .060" exists between the tip of the interlock and the top of the tooth on the shift clutch ratchet.

CAUTION: Be sure the interlock cam is in the correct sector of its orbit. This can be checked by tripping the cycle clutch and hand cycling a character. The interlock must move toward the shift ratchet immediately.



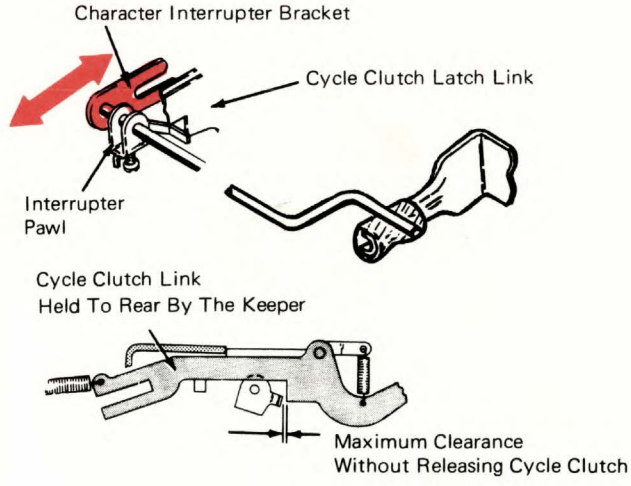
9. *Character Interrupter* – Adjust the character interrupter to satisfy the following conditions:

a. Adjust the interrupter pawl radially on the interrupter bail for minimum clearance between the interrupter pawl and the cycle clutch latch link when the cycle clutch latch link is in the released position and the shift is at rest.



(Side View)

b. Adjust the interrupter bracket front to rear to obtain maximum clearance between the interrupter pawl and the cycle clutch latch link when the shift is partially operated. This clearance should not be wide enough to allow the cycle clutch to trip.


Character Interrupter Bracket
Cycle Clutch Latch Link
Interrupter Pawl
Cycle Clutch Link Held To Rear By The Keeper
Maximum Clearance Without Releasing Cycle Clutch

(Side View)

FINE ALIGNMENT OPERATIONAL THEORY

Fine alignment is defined as locking and supporting the typehead in place so that the desired character will print clearly. In this section we will discuss how the typehead is detented and locked into position for printing. The desired character is brought to the approximate print position in front of the platen by the selection mechanism. Just prior to printing, the typehead must be detented in position both horizontally and vertically. After the print operation occurs, the tilt and rotate detents are withdrawn, allowing the selection mechanism to return the typehead to rest. (Fig. 1)

The carrier assembly is supported in front by the print shaft. The print sleeve is keyed to the print shaft causing it to turn when the print shaft rotates. The print sleeve turns within two bearings in the carrier casting. (Fig. 2)

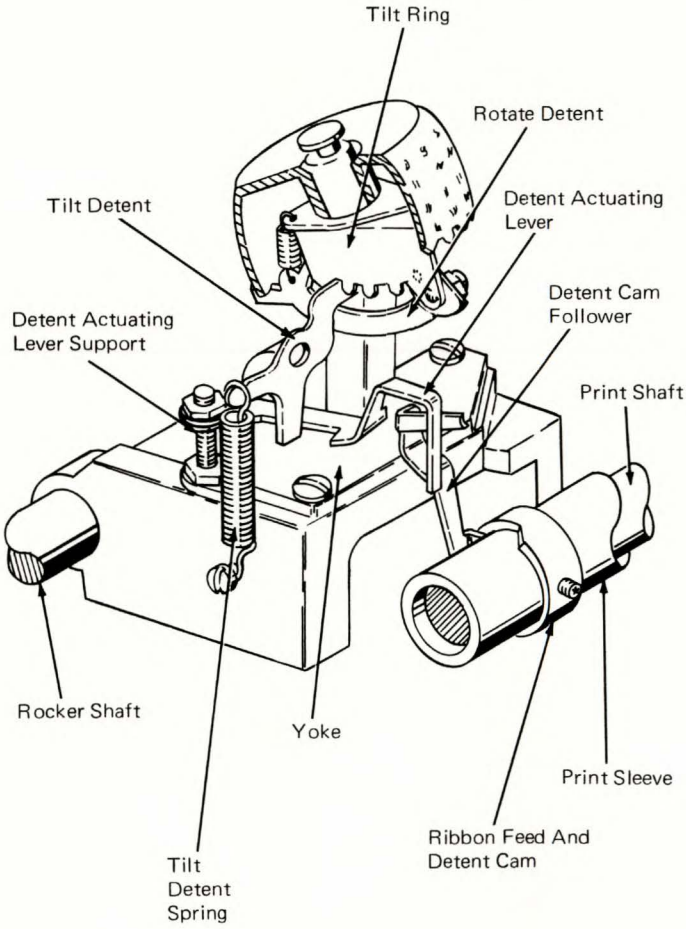


Figure 1 – Detent Mechanism

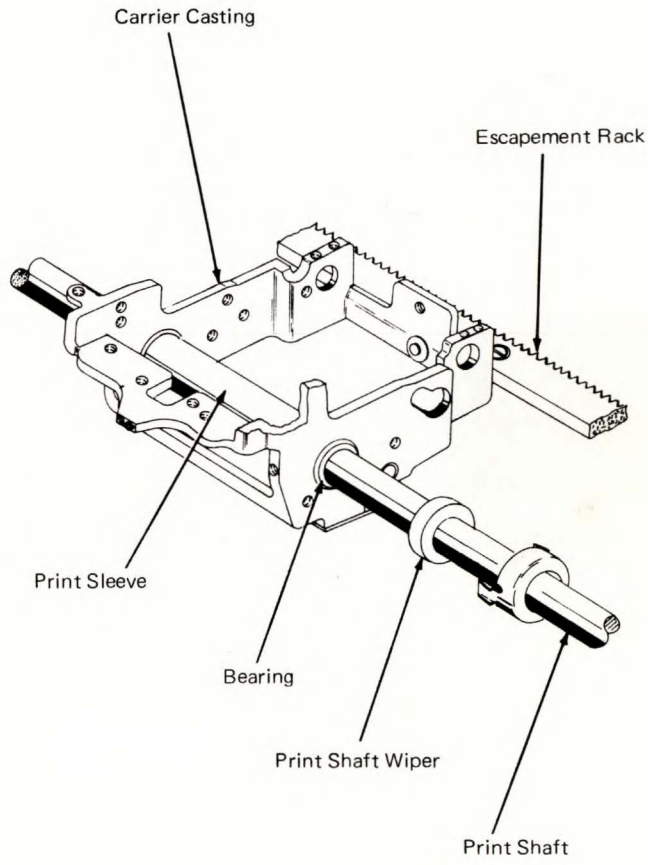


Figure 2 – Front Carrier Support

The rear of the carrier is supported by the front edge of the escapement rack. The carrier has two shoes, an upper carrier shoe and a lower carrier shoe. The lower shoe is a small block fastened to a plate and mounted on the carrier. The upper carrier shoe is mounted by an eccentric stud. (Fig. 3)

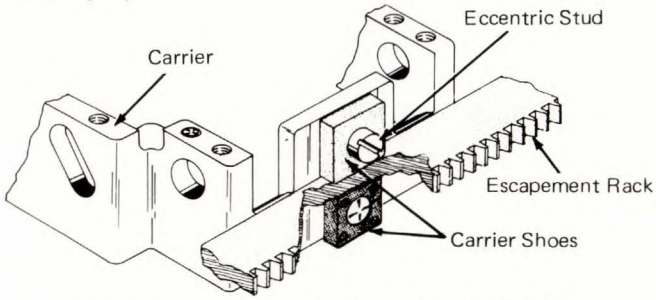


Figure 3 – Rear Carrier Support (Level 1) (no load spring)

A load spring is used on the new style support and maintains a constant pressure on the upper carrier shoe and removes the play between the lower shoe and the bottom of the escapement rack. This eliminates any vertical play at the rear of the carrier during a print operation. (Fig. 4)

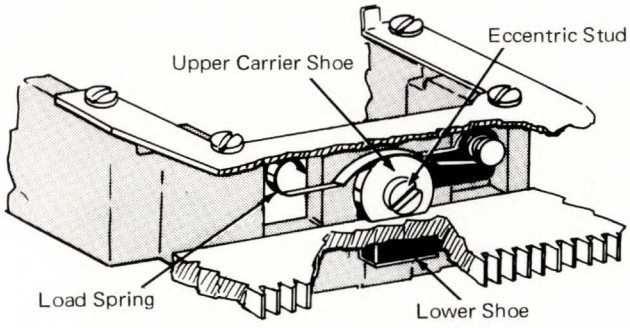


Figure 4 – Rear Carrier Support (Level 2)

The rocker assembly pivots about the rocker shaft at the rear of the carrier. At the proper time in the cycle, the print cam, also located on the print sleeve, drives the rocker about its pivot point, causing the typehead to strike the paper. (Fig. 5)

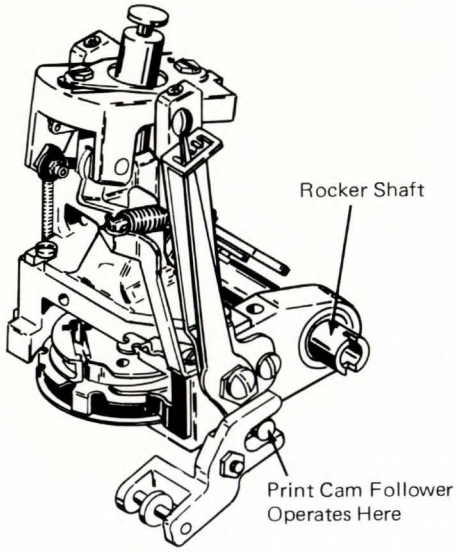


Figure 5 – Rocker Assembly

The fine alignment mechanism is located within the carrier assembly. There is a separate detent for both tilt and rotate. The tilt detent directly controls the rotate detent. If the tilt detent fails to seat in the detent notch, the rotate detent cannot seat in its notch. Both detents are spring loaded into engagement. When detenting occurs, the tilt detent will be spring loaded into a notch in the tilt ring. When the tilt detent enters a tilt ring notch, the rotate detent will be allowed to enter a notch in the skirt of the typehead. These detents are power driven out of engagement. (Fig. 6)

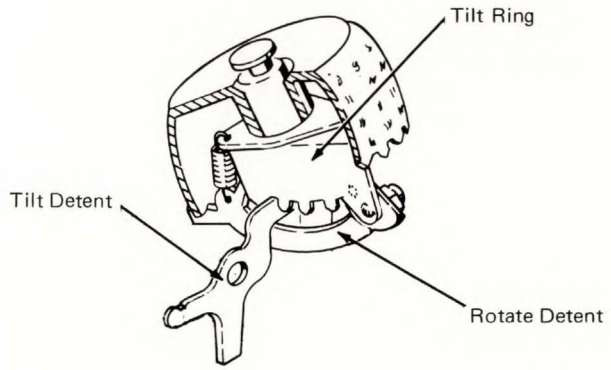


Figure 6 – Tilt And Rotate Detents

The detents are controlled by the detent cam through the detent cam follower and detent actuating lever. The spring load of the detents causes the detent cam follower to ride the surface of the detent cam. As the detent cam follower enters the low dwell of the detent cam, the detent actuating lever will allow the tilt detent to enter a notch in the tilt ring and the rotate detent to enter a notch in the typehead. As the print sleeve continues to rotate, the high dwell of the detent cam is encountered. The cam follower and the detent actuating lever will be driven to the left to remove the detents from the notches. This permits the selection mechanism to return the typehead to rest.(Fig.7)

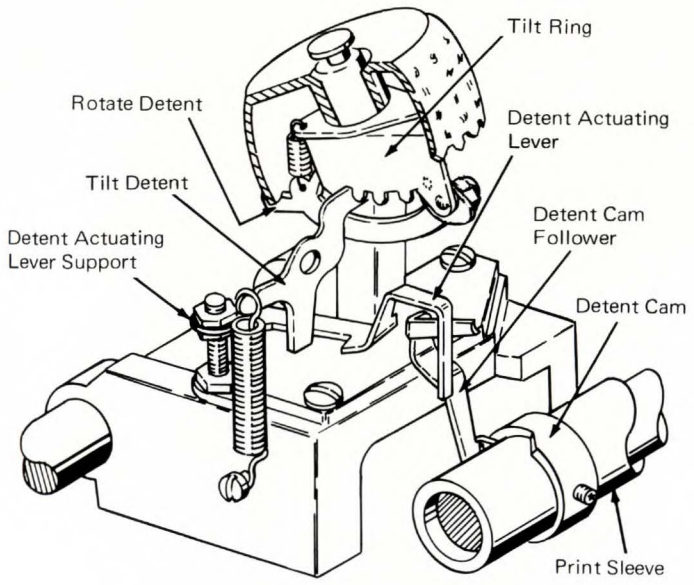


Figure 7 – Detent Mechanism

Vertical and horizontal alignment must be properly defined before any adjustments are attempted.

VERTICAL alignment problems exist when the letters are out of position this way. ↕ An example follows:

anbncndnenfngnhninjnknlnmnnnonpnqnrnsntnunvnwnxnynzn
ANBNCNDNENFNGNHNINJNKNLNMNNNONPNQNRNSNTNUNVNWNXNYNZN

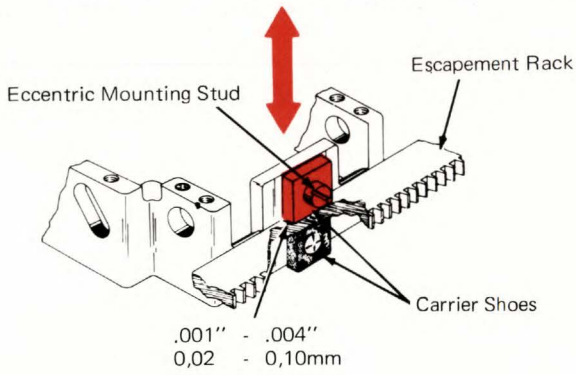
HORIZONTAL alignment problems exist when the letters are out of position this way. ↔ An example follows:

anbncndnenfngnhninjnknlnmnnnonpnqnrnsntnunvnwnxnynzn
ANBNCNDNENFNGNHNINJNKNLNMNNNONPNQNRNSNTNUNVNWNXNYNZN

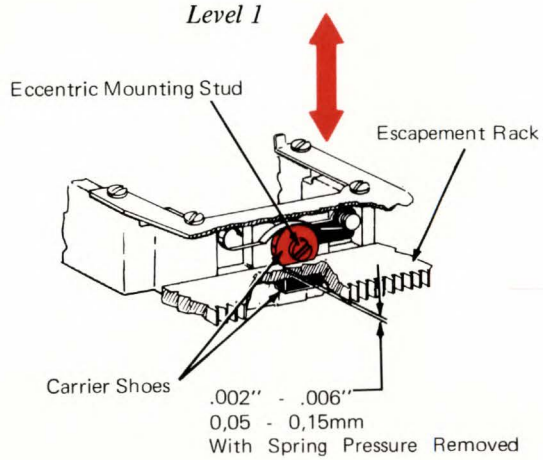
FINE ALIGNMENT ADJUSTMENTS

1. *Carrier Shoe* – Adjust the level 1 carrier shoe eccentric mounting stud to obtain .001"-.004" vertical play between the carrier shoes and the escapement rack. The level 2 carriers equipped with the spring loaded carrier shoe should be adjusted for .002"-.006" of vertical movement with the spring pressure removed. This adjustment should be checked at several points along the escapement rack.

   This amount of vertical play assures free horizontal movement of the carrier, yet restricts vertical movement to help prevent variation in the vertical alignment of the type characters.

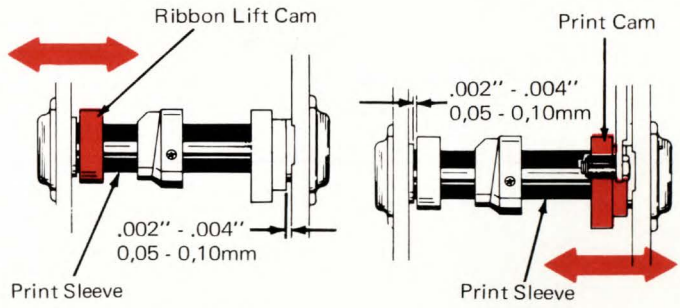


Level 1



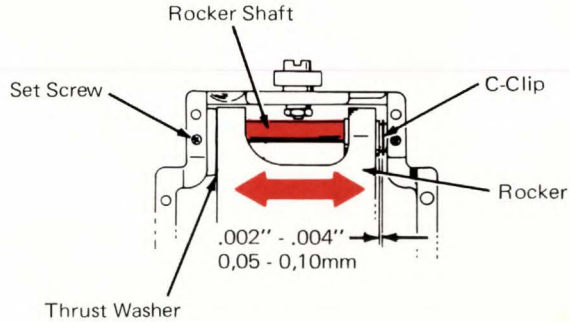
Level 2

2. *Print Sleeve Side Play* – The print sleeve must have .002"-.004" side play. On dual impression machines, this adjustment is obtained by adjusting the ribbon lift cam left to right. The print cam set screw tightens into a dimple in the print sleeve. On pre-dual impression machines, however, just the opposite is required. The set screw in the ribbon lift cam tightens into a dimple and the print cam is adjusted left to right to obtain the print sleeve end play.

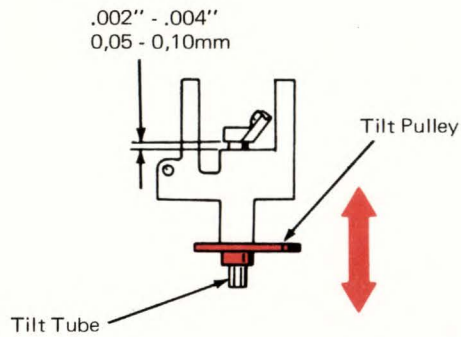


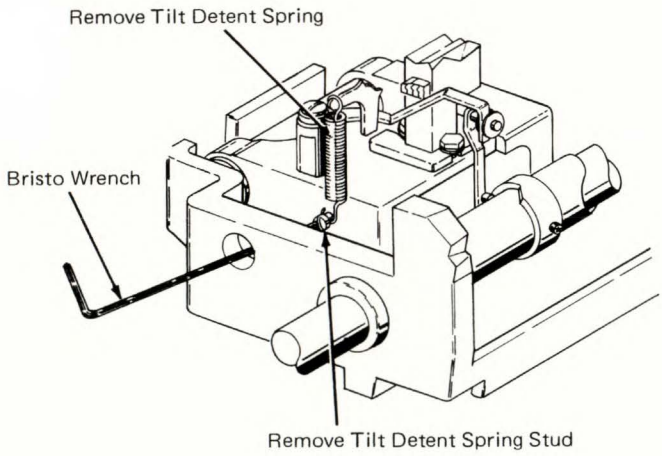
Dual Impression *Predual Impression*

3. *Rocker Side Play* – Adjust the rocker shaft to obtain .002"-.004" side play. The side play exists between a C-clip around the shaft at the right of the rocker and a thrust washer against the carrier casting at the left of the rocker. The rocker shaft is held in place by a set screw at the left end of the rocker shaft in the carrier casting. This adjustment should be kept to the minimum side of the specification.

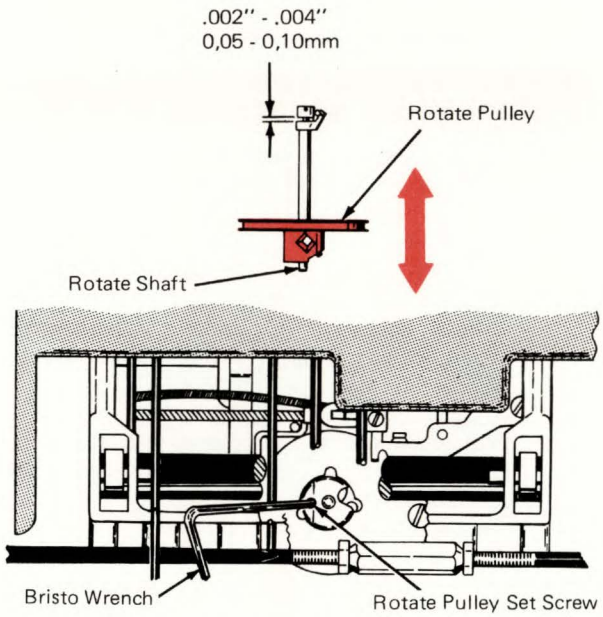


4. *Tilt Tube Endplay (Machines prior to gearless tilt)* – Adjust the tilt pulley vertically on the tilt tube to obtain .002"-.004" endplay. The tilt pulley is attached to the tilt tube by a setscrew and a key against a flat surface on the tilt tube. The setscrew is accessible through a hole in the left side of the carrier. Move the carrier to the right and remove the tilt pulley spring and the tilt detent spring. The tilt detent spring stud can then be removed through the hole in the carrier. The holes in the carrier and rocker will make the tilt pulley setscrew accessible with the bristo wrench. The height of the tilt sector gear is established by shimming between the gear and the top of the yoke. This height is set to obtain minimum backlash with no binds between the tilt sector gear and the tilt ring gear.





5. *Rotate Shaft Endplay* – Adjust the rotate pulley vertically to obtain .002"-.004" vertical motion of the rotate shaft. The rotate pulley is secured to the rotate shaft by a wedging block and a setscrew. The pulley is accessible from the bottom of the machine with the carrier centered over the cycle shaft and the machine in upper case. DO NOT rotate the rotate shaft when the pulley is loose as this affects homing. Recheck typehead homing after making this adjustment.

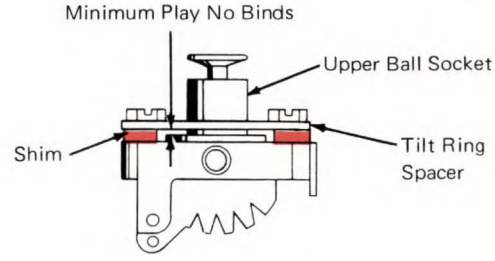


Bottom View

6. *Upper Ball Socket* – Shim the tilt ring spacer so there is no vertical play in the upper ball socket but it is still free to rotate.

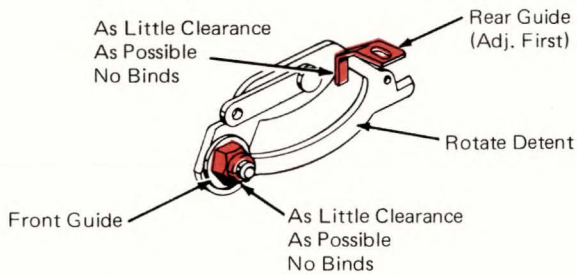
Vertical play in the upper ball socket will affect vertical alignment and impression because the typehead will not maintain a definite position when printing.

A bind in the upper ball socket can result in poor horizontal alignment if the rotate detent fails to seat in the detent notch before print occurs. A bind can also cause the nylon roller to drop on compensator equipped machines during a negative selection. Binds in the carrier area can be detected by manually operating the shift arm in and out with the typehead installed.

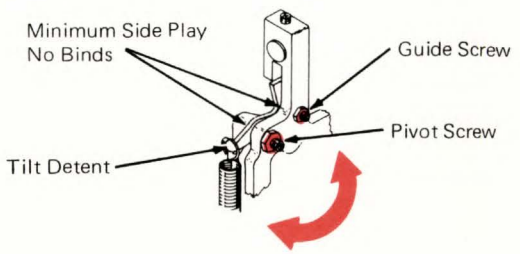


7. *Rotate Detent* – Adjust the front and rear rotate detent guides so the detent will operate vertically with no binds, but has no horizontal movement. This adjustment should be checked by half cycling a "J" and checking for rotational movement of the typehead. Excessive play in the rotate detent will cause poor horizontal alignment because the detent will not positively position the typehead.

This adjustment can best be made with the tilt ring off of the machine. Loosen the front guide nut approximately a half turn to assure that it will not interfere while adjusting the rear guide. Remove the rotate detent spring and adjust the rear rotate detent guide until a very slight amount of friction exists as the rear tip of the detent is moved up and down. It should be noted that the rear guide is on an angle and the closer the detent travels to the tilt ring, the tighter it will be wedged. Reconnect the rotate detent spring and adjust the front guide adjusting nut until it restricts the rotate detent from being pulled to its seated position by the rotate detent spring, then loosen the nut until the detent snaps into place. This method will give minimum clearance with no binds. If you removed the tilt ring, do not reinstall at this time.

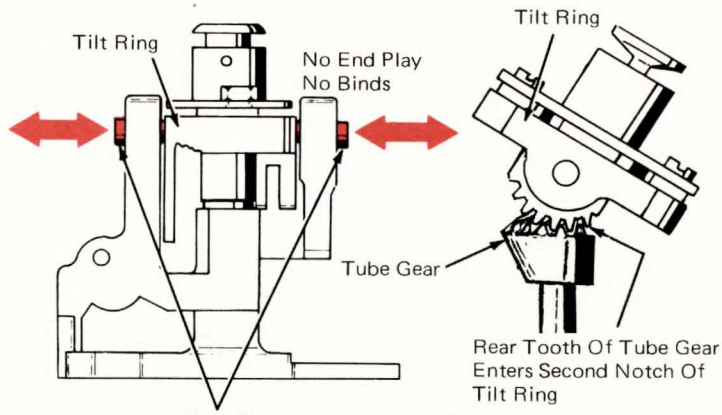


8. *Tilt Detent* – The tilt detent should pivot freely about its pivot screw but have no side play. This can best be achieved by loosening both the pivot screw and the guide screw and disconnecting the tilt spring. If you did not have to remove the tilt ring to perform the rotate detent adjustment, disconnect the rotate detent spring. Adjust the pivot screw until it produces a very slight amount of friction on the tilt detent lever and tighten the lock nut. Adjust the guide screw so that no side movement is allowed when the detent lever is operated past the guide screw. Reconnect the tilt and rotate detent lever springs.



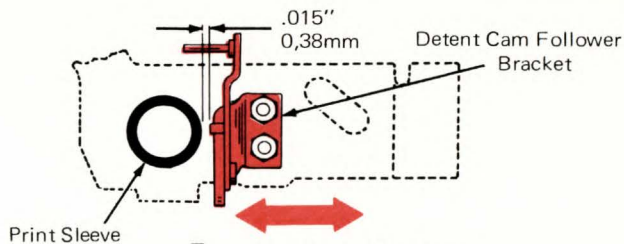
9. *Tilt Ring* – If the tilt ring had been removed previously, reinstall at this time. The tilt ring should be centered in the yoke with no side play. Adjust the pivot pins to satisfy this condition. Once installed there should be absolutely no side play to the tilt ring.

Note: On machines prior to the gearless tilt mechanism, care should be taken to ensure that the tilt sector gears are properly matched whenever the tilt ring is installed. The rear tooth of the tube sector gear should enter the second tooth of the tilt ring sector gear.

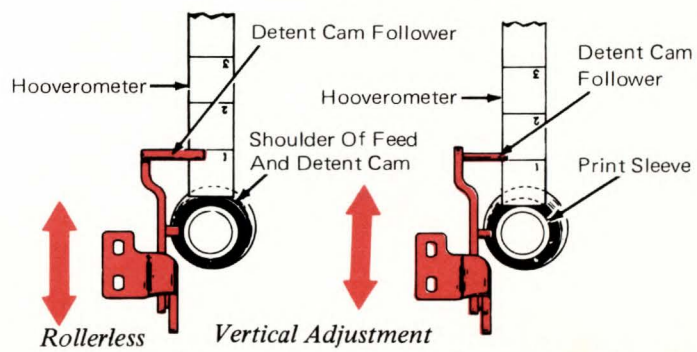


Gear Tilt Mechanism

10. *Detent Cam Follower* – The detent cam follower mounting bracket should be adjusted to satisfy the following conditions: (a) Front to rear for a clearance of .015" between the print sleeve and the end of the pin on the cam follower. (b) Vertically so the top of the cam follower is in line with the No. 1 scribe line on the Hooverometer with the Hooverometer resting on the print sleeve. Machines equipped with a roller on the detent cam follower should be positioned so the bottom surface of the pin is in line with the No. 1 scribe line.



Front To Rear Adjustment

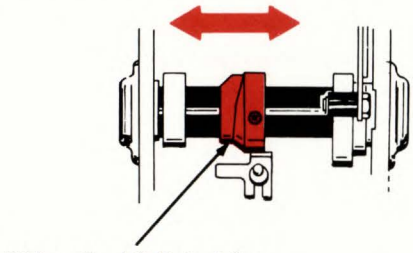


Rollerless Detent Cam Follower

Vertical Adjustment

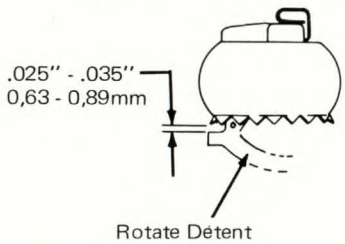
Roller Detent Cam Follower

11. *Detent Skirt Clearance (Machines prior to gearless tilt)* – The detent mechanism must be adjusted to satisfy the following conditions: (a) Position the ribbon feed and detent cam left to right on the print sleeve so that the inside rib of the cam will be in line with the left hand edge of the ribbon feed cam follower.



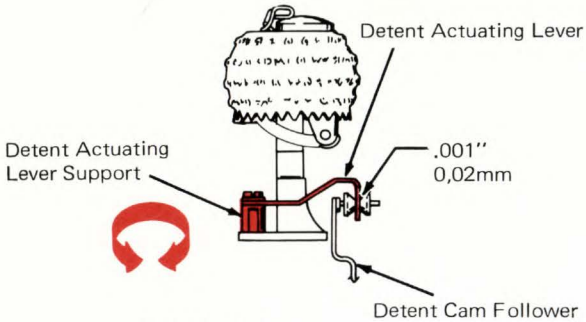
(b) Adjust the detent actuating lever support front-to-rear so the rotate detent will clear the teeth on the typehead skirt by .025"-.035" when the cycle shaft is at rest. This clearance should be observed when the typehead is manually rotated to the tilt two position.

At Rest – 2 Tilt Oper. Manually



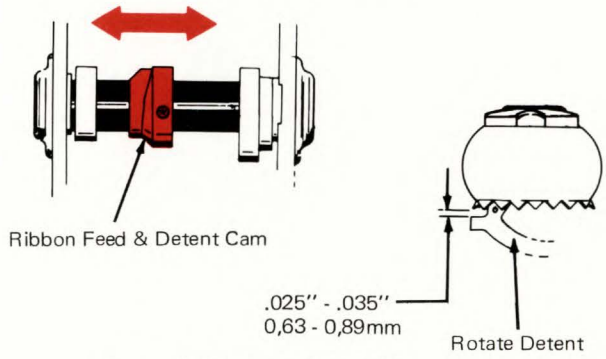
(c) With the detent cam follower on the low dwell of the detent cam, rotate the actuating lever support until .001" clearance is felt between the detent actuating lever and the detent cam follower roller.

Note: The above adjustments of the detent mechanism directly affect each other and must be adjusted alternately to obtain the correct clearances.



Half-Cycled

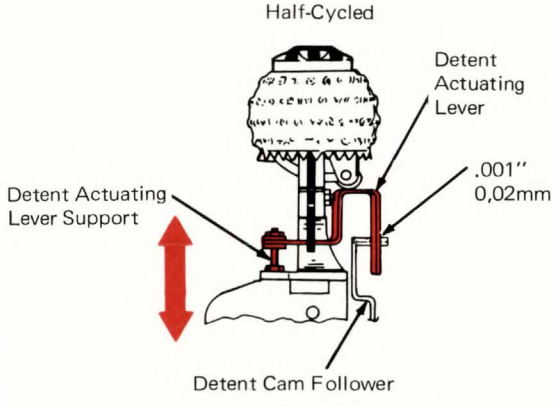
12. *Detent Skirt Clearance (Gearless tilt)* – The detent mechanism must be adjusted to satisfy the following conditions: (a) With the cycle shaft at rest and the typehead manually held at the tilt two position, adjust the ribbon feed and detent cam left to right on the print sleeve to obtain .025"-.035" clearance between the rotate detent and the teeth on the typehead skirt.



At Rest – 2 Tilt Oper. Manually

(b) With the detent cam follower on the low dwell of the cam, loosen the lock nut on the detent actuating lever support and adjust the bristo screw up or down until there is a clearance of .001" felt between the detent actuating lever and the detent cam follower.

Note: These two adjustments directly affect each other and must be adjusted alternately to obtain the correct clearances.



Half-Cycled

The purpose of the tilt mechanism is to select the desired horizontal character band so that a character in that band may be brought to the printing point. The typehead clips to the upper ball socket. The upper ball socket mounts in a platform-like part called the tilt ring. The tilt ring pivots on two pivot pins between the yoke arms, inside the hollow part of the typehead. The yoke assembly is fastened to the rocker assembly. (Fig. 1)

The tilt ring is located in about the center of the typehead and causes the typehead to tilt as the tilt ring pivots about its pivot pins. The typehead rests with the upper band of characters in the print position and all tilt positions are upward from the rest position. There are two levels of mechanisms employed to move the tilt ring. The early mechanism used a pair of beveled sector gears with a pulley and tube to move the tilt ring. The gearless tilt mechanism accomplishes the same thing, but does not have the beveled gears. The tilt pulley is mounted on an angle on the rocker and is connected to the tilt ring by a link. A pull on the tape causes the tilt pulley to rotate about its mounting stud and transfers motion to the tilt ring. When the pull on the tape is relaxed, the tilt pulley is restored to rest by an extension spring. The tilt pulley link is fastened to the tilt pulley by a ball shouldered rivet to allow the link to pivot in all directions.

The left hand tilt pulley is mounted to the tilt arm on a ball shouldered pivot screw. This allows the pulley to remain horizontal regardless of the position of the tilt arm. It must remain horizontal to prevent the tape from coming off the pulley.

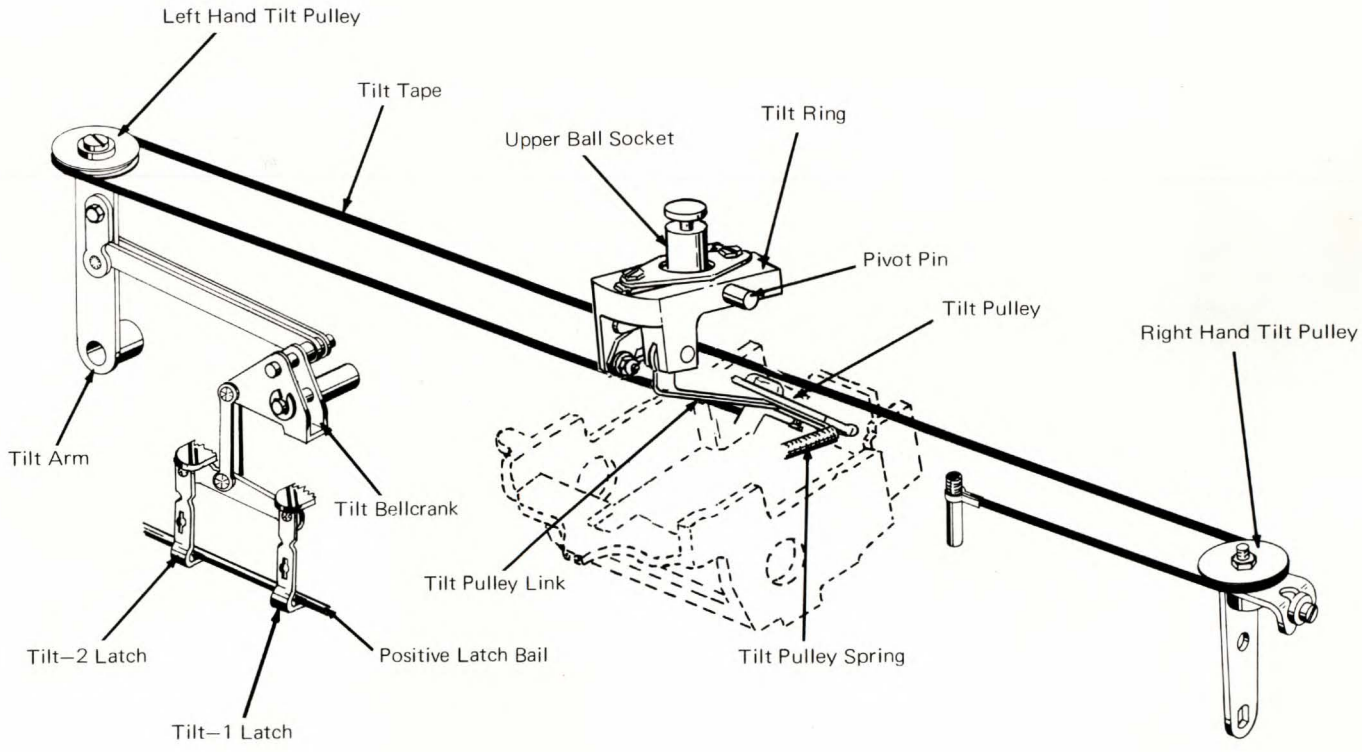


Figure 1 – Tilt Tape System (Gearless Tilt)

Most problems in the tilt mechanism will show up as a vertical alignment failure on the paper. However, the tilt detent controls the rotate detent. If the tilt detent fails to seat in the tilt ring, it is possible for the rotate detent to fail to seat in the typehead. This could cause horizontal alignment failures on the paper. (Fig. 2)

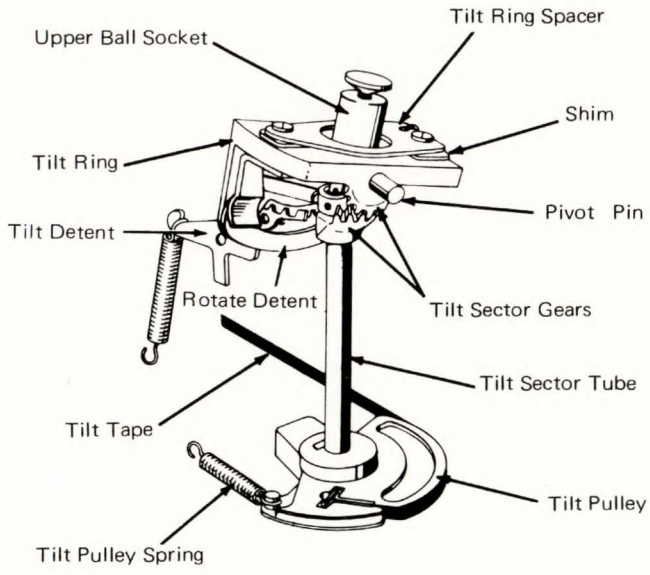


Figure 2 – Gear Tilt Mechanism

The typehead is positioned throughout four tilt band positions by two latches. (Fig. 3) Tilt band 0 does not use either latch. Tilt band 1 requires the T1 latch to remain under the bail and causes the tilt arm to move one band of movement. (Fig. 4) To select the tilt 2 band, the T2 latch remains under the bail and the T1 latch is removed, thus causing the tilt arm to move two bands of movement. The fourth band of the typehead or the tilt 3 position, requires both tilt latches remain under the bail to give three bands of motion to the tilt arm.

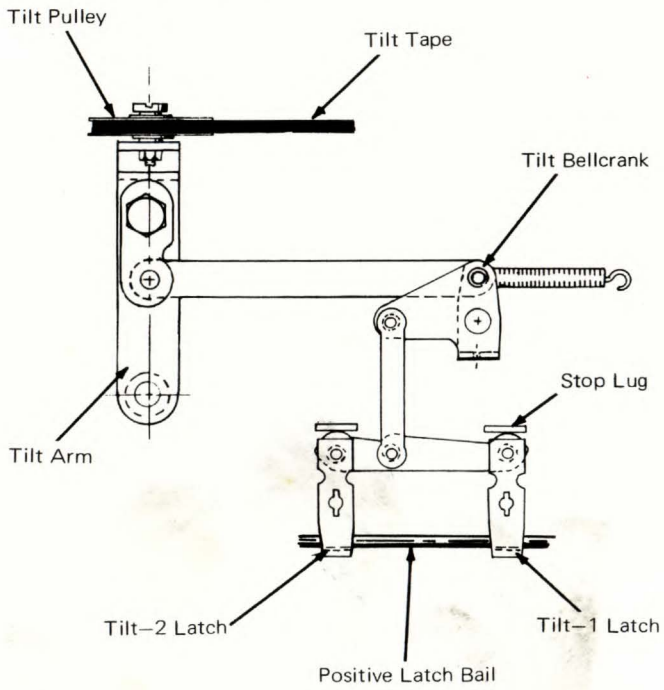


Figure 3 – Tilt Differential At Rest

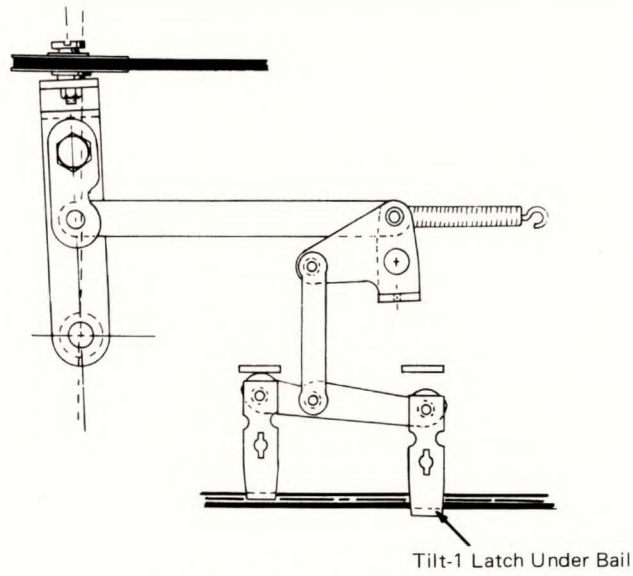
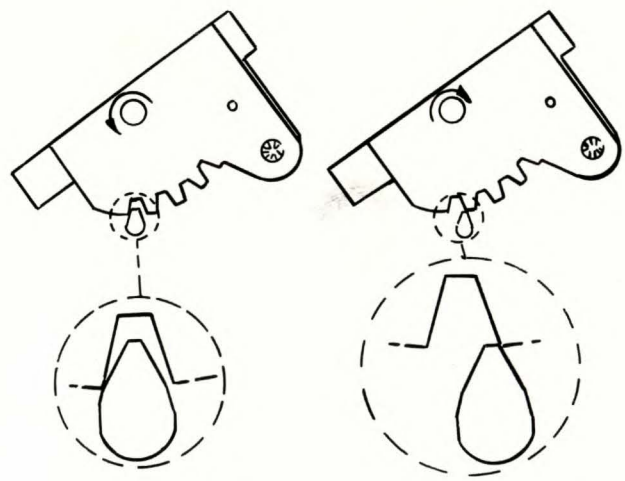


Figure 4 – Tilt - 1 Operation

If you have a vertical alignment failure, first remove the typehead from your machine. Check the detenting on the "Z" and "J". Make sure the tilt ring is detenting properly when the play is removed in the negative direction. Also, make sure you check the detenting by removing the play in the positive direction. This will tell you if the "tilt ring play" is correct and, more important, if the detent is catching on the tip of the notch. If the detent catches on the tip of the notch, the tilt detent will fail to seat and it will restrict the rotate detent from seating in the typehead tooth. This will look like a "fine alignment" problem although it is a coarse alignment problem. If the tilt detent is not catching on the tip of a detent notch, but it still fails to seat, you may have a "fine alignment" problem. (Fig. 5)

Tilt adjustments are included with "Character Selection Adjustments" starting on Page 34 (this section).



Play Removed In The Negative Direction

Play Removed In The Positive Direction

Figure 5 – Tilt Detent Entry

CHARACTER SEL (ROTATE) OPERATIONAL THEORY

The purpose of the rotate mechanism is to position the typehead rotationally to any of the eleven rotational positions. The rotate mechanism is similar to the tilt mechanism, however, it is more complex. Coarse alignment will position the typehead to the correct approximate position. The built-in headplay allows the rotate detent to refine the coarse aligned position. Headplay results from backlash between the slots of the dog bone and the pins in the upper and lower ball sockets. In this section, we will be concerned only with coarse alignment of the typehead. (Fig. 6)

Once the rotate mechanism has positioned the typehead so the rotate detent is seated within the V-shaped notch in the skirt of the typehead, any horizontal misalignment problems cannot be attributed to coarse alignment adjustments. The problem lies in the carrier and rocker area and is usually caused by one or more of the following: side play in the rotate detent, improper detent timing, vertical or horizontal play in the upper ball socket, excessive side play of the rocker, or anything that will restrict carrier movement.

Rotate selection is accomplished by four latches. There are three positive and one negative latch. Various combinations of these latches position the typehead to one of the eleven rotational positions. The latches have rotational incremental values assigned to them. They are from left to right, R2A, R1, R2 and negative 5. Latch R2A is never used by itself and is only used for rotational positions 4 and 5. Latches R1, R2, and R2A provide 1, 2, 3, 4, and 5 increments of counterclockwise or positive rotation, depending on the combination operated. Those latches not needed are removed from beneath the bail by links connected to the latch interposers in the keyboard. The -5 rotate latch rotates the typehead five units in the clockwise or negative direction. Lesser increments of negative rotation are selected by including one or more positive increments (latches) with the negative 5. The negative 5 latch, however, must be activated to be effective.

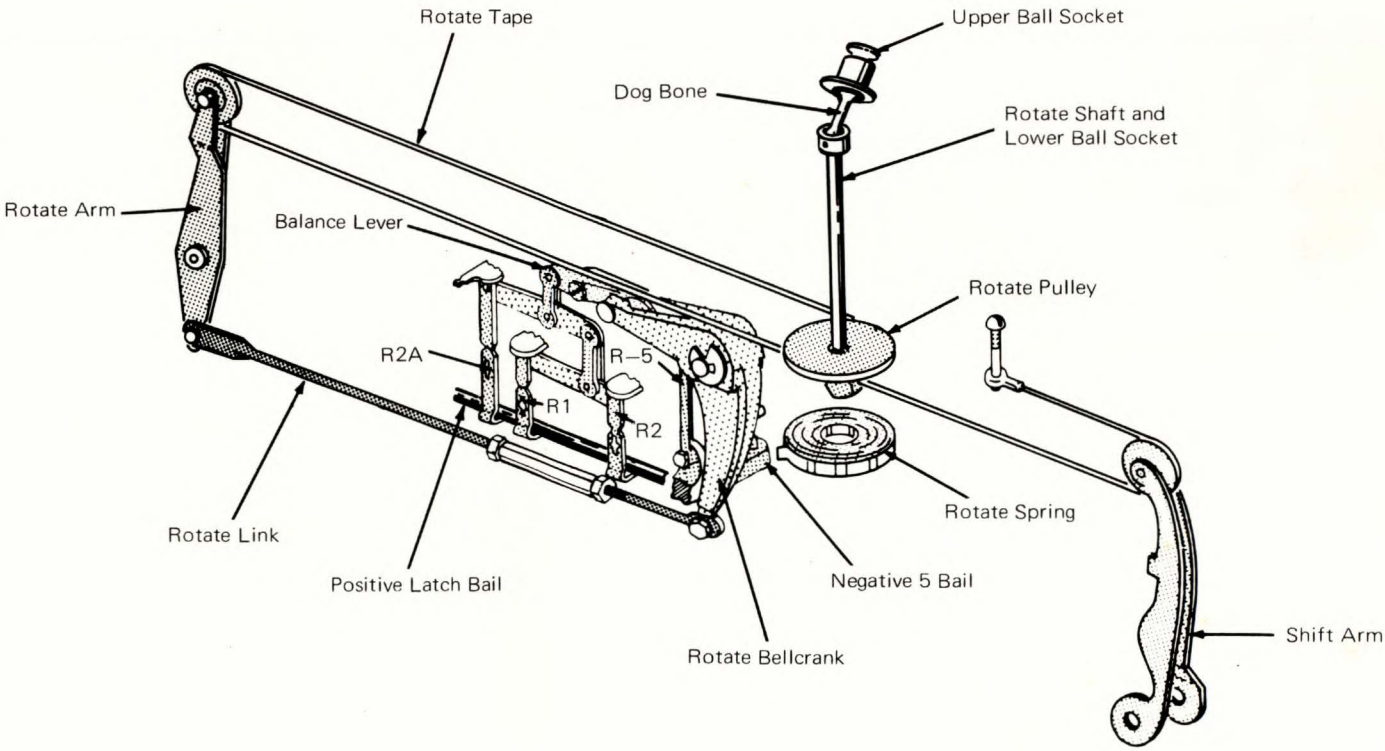


Figure 6 – Rotate Tape System

The motion obtained from the selection latches is transmitted through a bellcrank, link and rotate arm. The position of the rotate arm controls the effective length of the rotate tape. When a latch is pulled down, the opposite end of the lever tries to move up, but is held by a stationary stop pad. Motion is then transferred to linkage and to the rotate bellcrank. To equalize the amount of motion received from the positive latches and the negative bail, a balance lever is located between the negative 5 bail and the positive latches. This lever is adjusted so the positive motion from the positive latches and negative motion from the negative latch are cancelled and no movement of the typehead is observed. (Fig. 7)

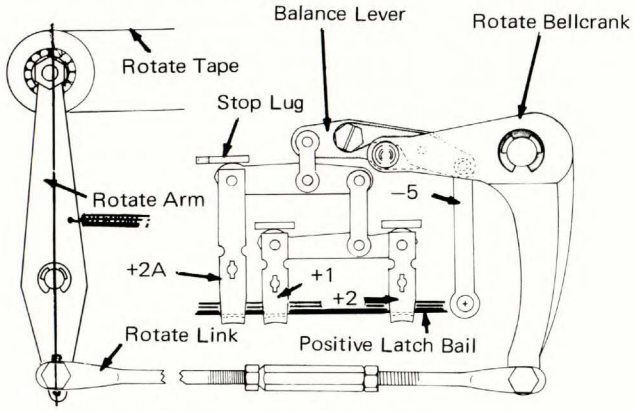


Figure 7 – Rotate Differential At Rest

In Fig. 8, the +1 and +2 latches are under the positive latch bail to give a positive 3 rotation.

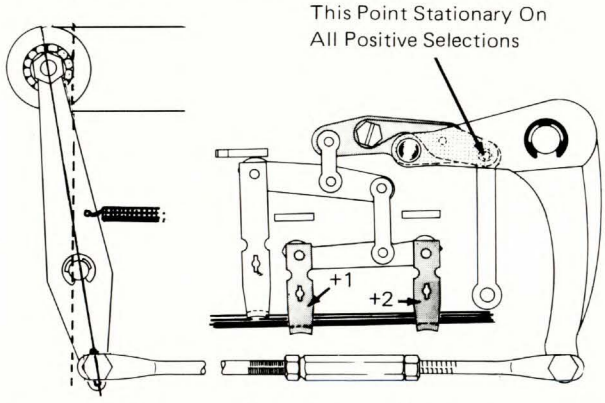


Figure 8 – Positive - Three Rotate Operation

In Fig. 9, the negative five bail is allowed to operate. This provides a negative 5 rotation.

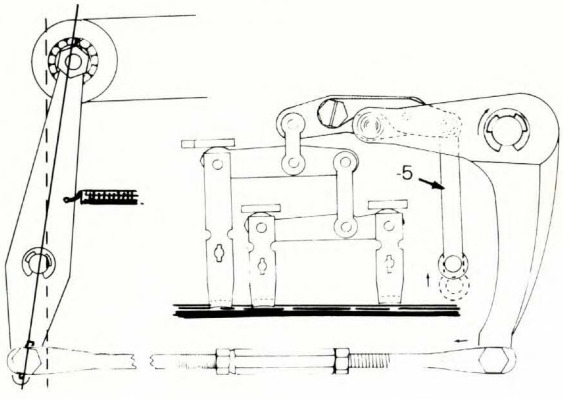


Figure 9 – Negative-Five Rotate Operation

In Fig. 10, the +2 latch and the negative 5 bail "add" together to provide a negative 3 rotation.

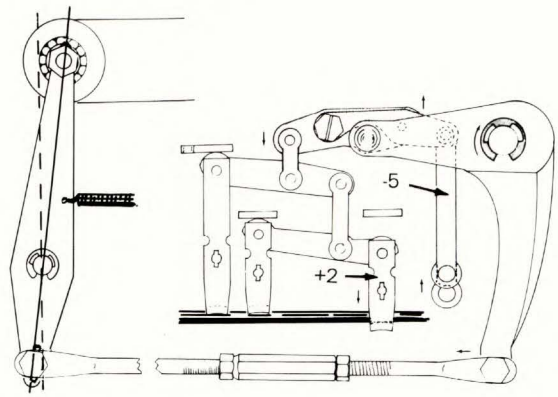


Figure 10 – Negative-Three Rotate Operation

Any wear in the system will cause the typehead to drift in the negative direction. This is because of the rotate spring applying a constant pressure to the rotate system in a negative direction. Because of this drift, coarse alignment or homing adjustments should be checked each time the machine is visited. (Fig. 11)

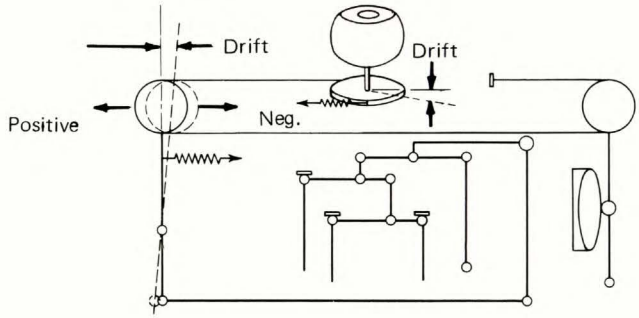


Figure 11 – Rotate System Drift

Early level machines included a wear compensator on the rotate arm. The wear compensator did not prevent wear, but prevented most head drift due to wear in the system. The wear compensator is composed of three basic parts: the rotate arm, the compensating arm, and a nylon roller between them. For all rotate positions between +5 and -3, it works the same as the current solid arm. (Fig. 12)

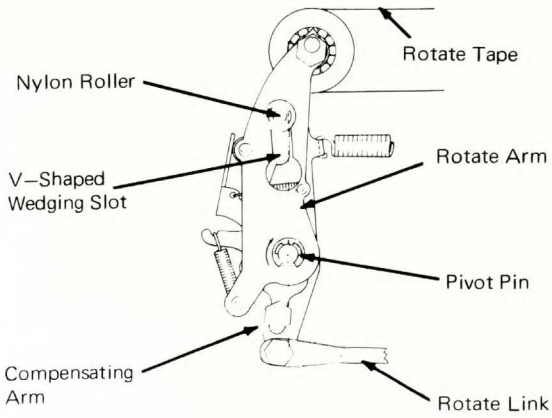


Figure 12 – Basic Components Of The Wear Compensator

Between rotate position -3 and -5 a ratio change occurs and provides the compensating arm with more motion. At the negative 5 position a stud on the rotate arm contacts the side frame and prevents further movement of the rotate arm. Wear in the system would cause the compensating arm to continue moving and allow the nylon roller to drop in its V-shaped wedging slot between the rotate arm and compensating arm, thereby compensating for any system drift.

Wear potential in the rotate mechanism is defined as the ability of the rotate mechanism to properly align the typehead after a measurable amount of uncompensated wear is felt in the mechanism. A portion of the typehead play provides the rotate system with a substantial amount of wear potential. To explain how this is accomplished let's look at the relationship between headplay, homing and bandwidth. (Fig. 13)

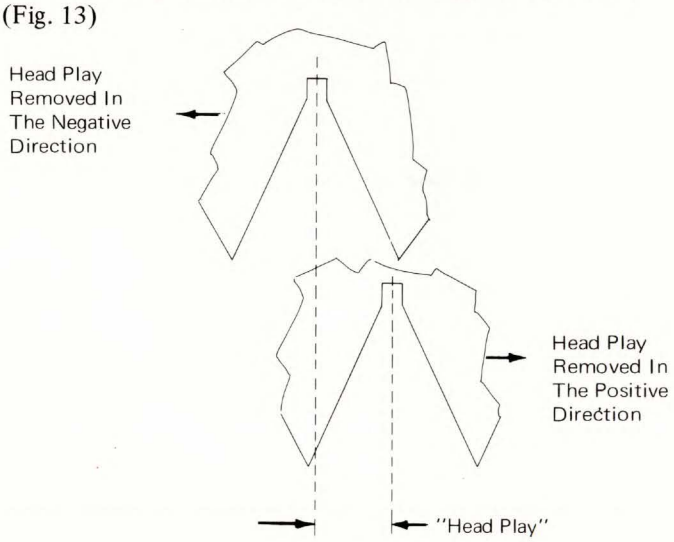


Figure 13 – Typehead Play

Typehead play is .050" to .060" measured at the typehead skirt or slightly less than half the distance between teeth. The headplay is split between the positive and negative slopes of the typehead notch. The element is homed so that the rotate detent contacts the notch slope, with the headplay removed in the negative direction, approximately .015" down the negative side of the notch. (Fig. 14)

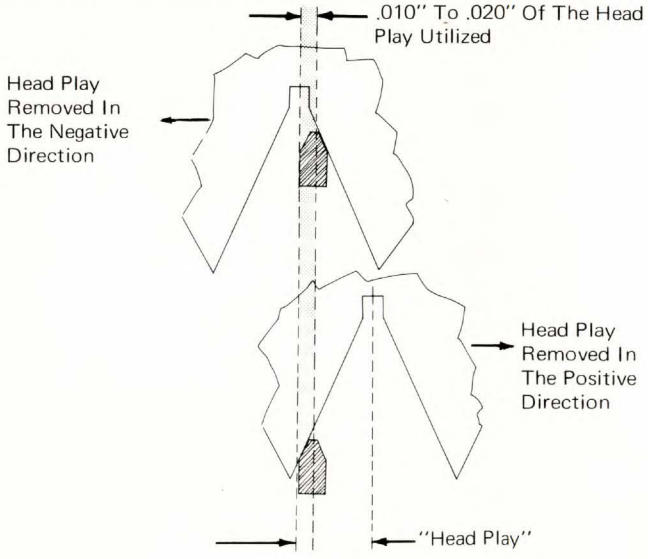


Figure 14 – Typehead Homing

The purpose of this adjustment is to provide maximum wear potential to the system. Also, this adjustment tends to allow more time to withdraw the detent before the typehead restores in the positive direction. Breakage in the system would occur if the detent did not withdraw prior to typehead movement.

Next, let's consider bandwidth. With the headplay removed in the negative direction, the greatest variation between detenting of one typehead position (Fig. 15A) and another typehead position (Fig. 15B) is called bandwidth. It is caused by unequal adjustment of the rotate latch stop pads. You will note that we have now used up almost 3/4 of the negative slope of the typehead notch. The remaining distance of the slope is considered the wear potential. The typehead can drift without causing problems until the most negative detented position falls near the end of the negative slope.

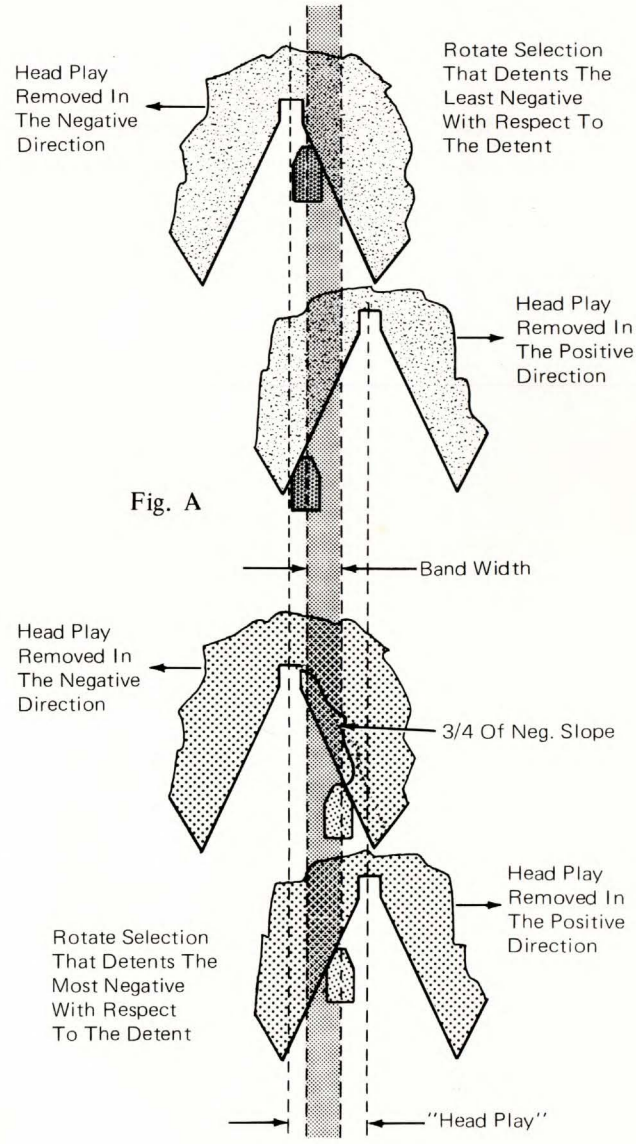


Figure 15 – Band Width

When wear occurs in the system, the typehead drifts in the negative direction with respect to the detent. This causes the headplay and bandwidth to drift in the negative direction with respect to the detent. As long as this drift does not exceed the wear potential portion of headplay, the detent will continue to fine align the typehead. Once the wear potential is exceeded, the rotate selection that coarse aligns the most negative, with respect to the detent, will fail to seat in the detent notch. The detent will then fail to seat causing that character to print out of alignment. From the preceding, one can see that for optimum performance, reliability and wear potential, bandwith must be controlled to be as small as possible. (Fig. 16)

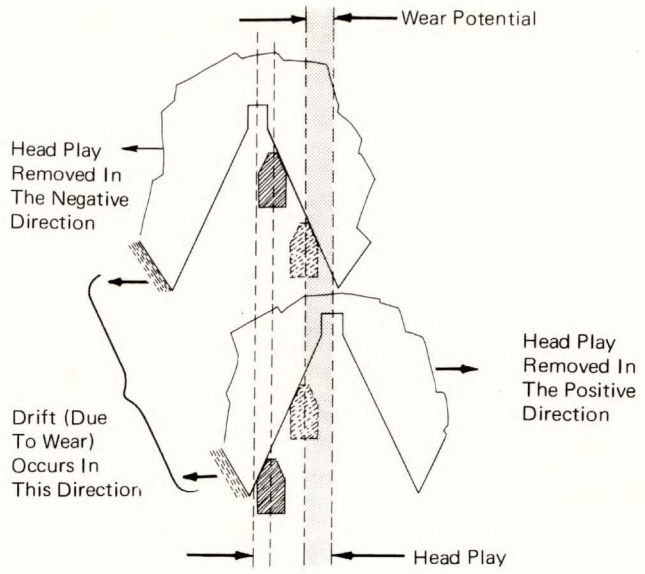
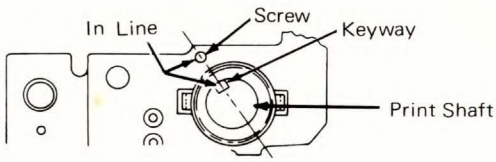

Wear Potential
Head Play Removed In The Negative Direction
Head Play Removed In The Positive Direction
Drift (Due To Wear) Occurs In This Direction
Head Play

Figure 16 – Wear Potential

CHARACTER SELECTION ADJUSTMENTS

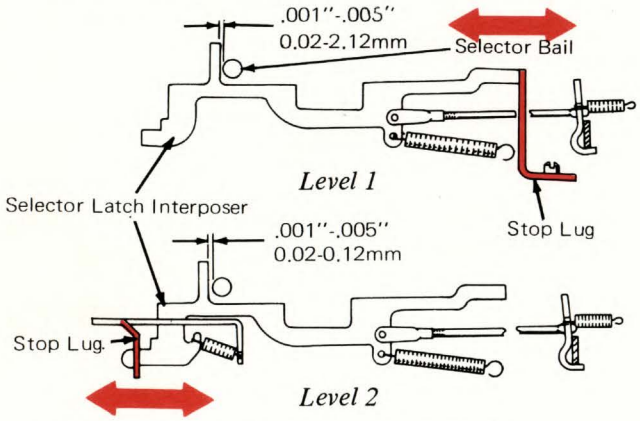
NOTE: Shift adjustments must be correct before attempting to make coarse alignment adjustments. Remove the typehead before beginning adjustments.

1. *Preliminary Timing* – Loosen the print shaft gear and the print shaft so that its keyway is in line with the screw on the left side of the carrier casting. This coarse adjustment assures that the detents will operate at approximately the right time in the cycle.

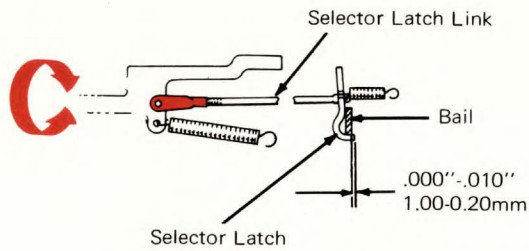


Preliminary Adjustment

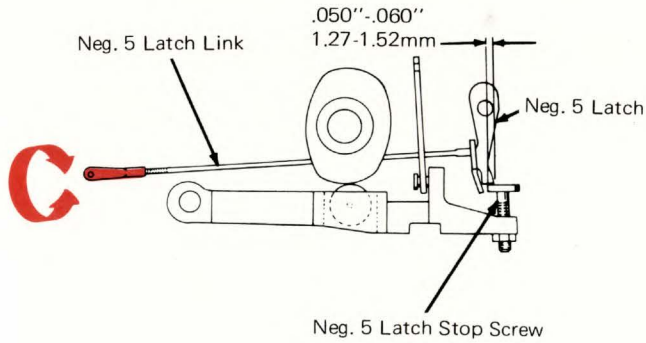
2. *Interposer Stop Lugs* – Form the selector latch interposer stop lugs to obtain .001" - .005" clearance between each latch interposer's upright lug and its respective selector bail. This adjustment establishes a fixed position for the interposers and will directly affect selection latch timing.



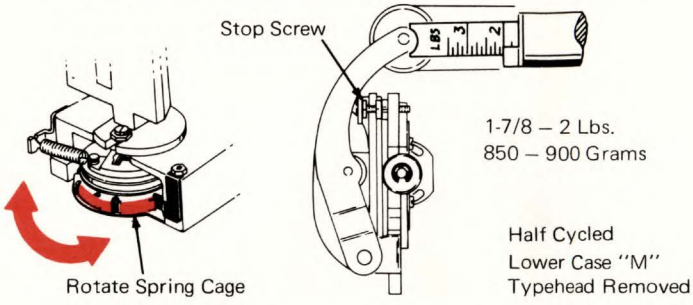
3. *Selector Latch Links* – With the machine at rest, adjust the selector latch links so that the tips of the latches overlap the bail with .000" - .010" overhang. More or less overhang can cause the latches to "pop" out from under the bail.



4. *Negative 5 Latch Link* – With the machine at rest, adjust the negative 5 latch link so that the negative 5 latch will overlap the stop screw head by .050" - .060"



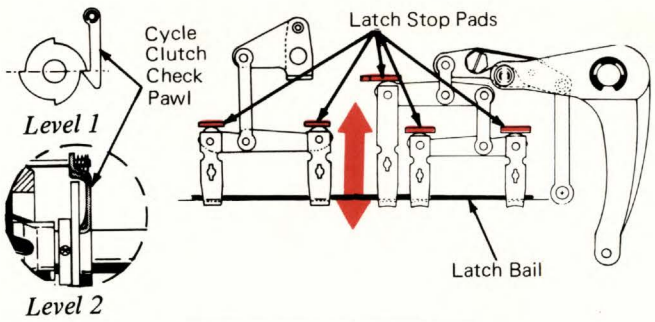
5. *Rotate Spring Tension* – Shift the machine into lower case and half-cycle an "m". Adjust the rotate spring cage until a 1 7/8 - 2 lb. reading is obtained on the spring scale just as the shift arm contacts the stop screw. This is a *CRITICAL* adjustment. Excessive tension will cause increased wear in the system; insufficient tension will not provide the torque necessary for rapid lower case negative rotate operations.



6. *Latch Stop Pads* – Form the latch stop pads by tapping them with a hammer and screwdriver. The latches should reset under the bail at the same time the cycle clutch check pawl resets.

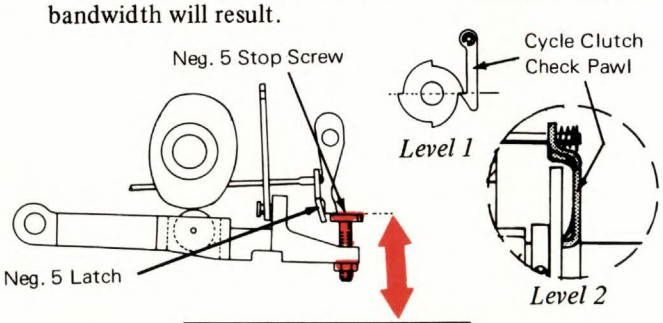
When adjusting the stop pads and the negative 5 latch stop screw, it is helpful to place a finger on the pawl while observing the latches resetting. This allows you to observe exactly when the latches reset and at the same time feel when the check pawl drops in.

It is not necessary to get the check pawl and latches *EXACTLY* together. If the resetting of the latches slightly precedes the pawl, consider this okay. If the latches lag the pawl, readjust their rest position.

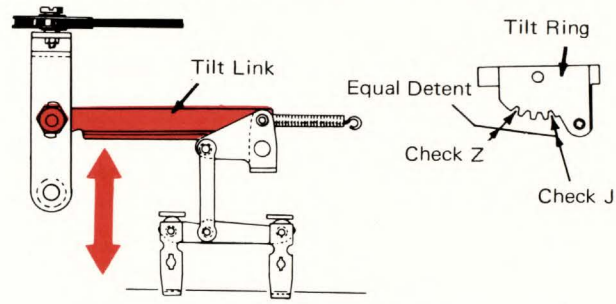


7. *Negative 5 Bail Stop Screw* – Adjust the negative 5 stop screw so that the negative five latch resets at the same time that the cycle clutch check pawl resets when a negative 5 character is slowly hand-cycled.

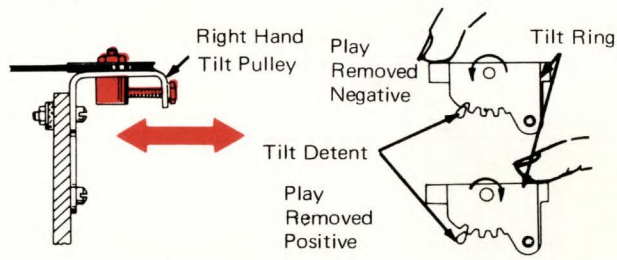
Note: Unless adjustments 6 and 7 are correct excessive bandwidth will result.



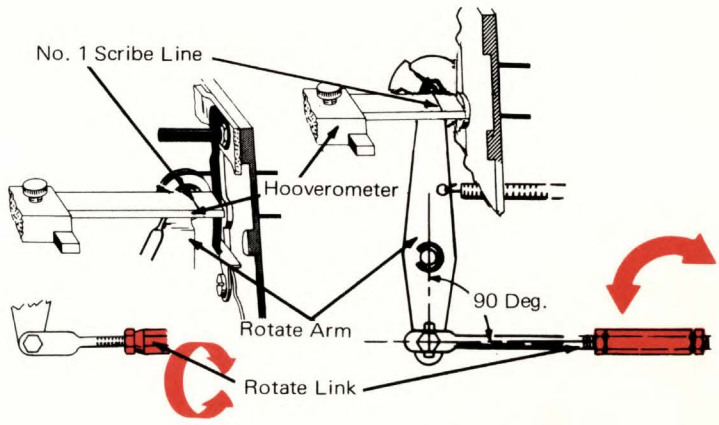
8. *Tilt Arm Motion* – Adjust the link up or down on the tilt arm so that the tilt ring will coarse align the same for a "Z" as it does for a "J".



9. *Tilt Ring Homing* – With a "Z" character half cycled and the tilt ring play removed in the negative direction (restoring direction), adjust the right hand tilt pulley so the rear of the tilt ring will rise approximately .010" when the detent is manually allowed to seat in the detent notch. As a further check remove the tilt ring play in the positive direction and observe the detent entry on the forward side of the notch. The detent should enter far down the forward slope of the detent notch, but not so far that it contacts the tip of the tooth. By homing the tilt ring off center, favoring the positive side of the detent notch, a maximum amount of wear potential is achieved.



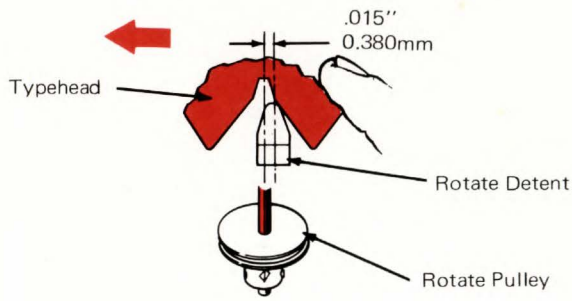
10. *Rotate Arm Vertical* – To ensure equal arcs of motion of the rotate arm for both negative and positive characters, the rotate arm must be vertical. This is a preliminary adjustment, and is made by adjusting the turnbuckle on the rotate link. Adjust the link so that the center of the top of the rotate arm is in line with the No. 1 scribe line of the Hooverometer when the Hooverometer is against the sideframe.



The remaining adjustments MUST be made with the machine in upper case. Reinstall the typehead.

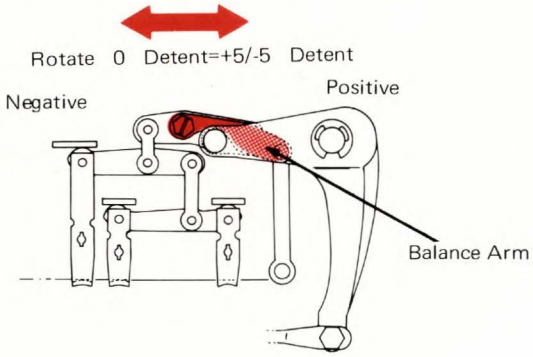
11. *Typehead Homing* – Half-cycle a "T" and check to ensure that the detent enters the proper tooth. If it does not, loosen the rotate pulley setscrew and slip the typehead around until the detent enters the correct tooth. Set the detenting in this tooth to approximately .015" down the negative slope of the typehead notch, with the headplay removed in the negative direction, before tightening the setscrew.

    It is not necessary to slip the typehead if the detent enters the correct tooth. Usually, refinement of the rotate link is sufficient to achieve proper homing.

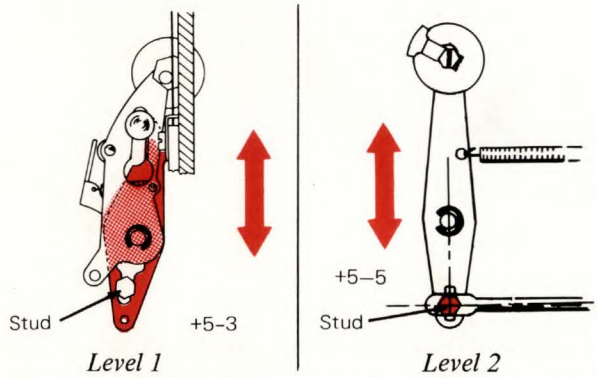


Upper Case

12. *Balance Arm* – The balance arm is adjusted to obtain proper balance between positive and negative selections. Make this adjustment by first half-cycling a "T" and observing its detent entry. Next, half-cycle a "B" while manually withholding the negative 5 latch. This will yield a "cancelled B" resulting in the "T" being selected. Now, adjust the balance arm left or right until the detenting of the "cancelled B" matches the detenting of the "T" previously observed.



13. *Rotate Arm Motion* – To provide the proper motion in each direction of typehead rotation, the stud at the bottom of the rotate arm must be vertically positioned in its slot. The correct position of the stud is determined by alternately observing the detenting of the "M" and "W" while changing the stud's position. When the detenting is equal, the stud is correctly positioned. Compensator equipped machines must use the "R" and "W" for this adjustment.



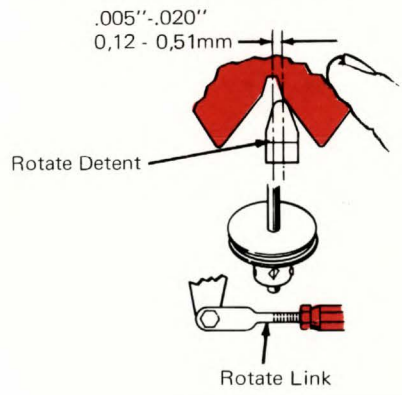
Level 1 *Level 2*

For all machines with the wear compensator assembly, skip adjustment 14.

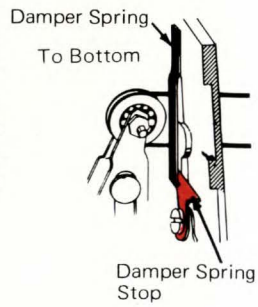
For all machines with the solid rotate arm, skip adjustments 15 through 19.

14. *Rotate Link* – Adjust the rotate link so the rotate detent contacts the negative slope of the typehead .005" - .020" from the center of the notch when the home character is half-cycled. This adjustment allows the greatest amount of wear potential available before a failure can occur.

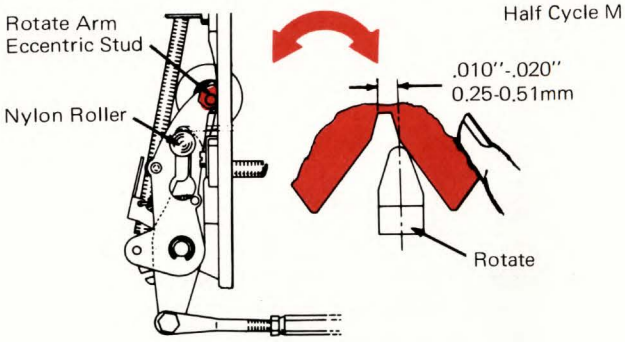
    REMEMBER, on machines using the solid rotate arm, homing should be checked on *EVERY* call.



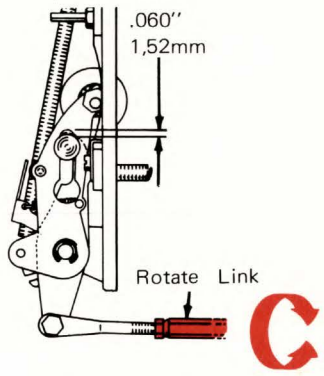
15. *Damper Spring Stop* – Move the damper spring stop to the bottom of the damper spring. This is a preliminary adjustment to prevent the damper spring from interfering with the following adjustments.



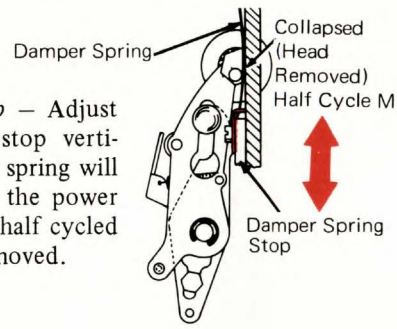
16. *Rotate Arm Eccentric Stud* – Half cycle an "M" and raise the nylon roller in its slot to insure it is not restricting the rotate arm. Adjust the eccentric stud rotationally so the rotate detent contacts the negative slope of the typehead .010" - .020" from the center of the notch. This adjustment allows the greatest amount of wear potential available before a failure can occur.



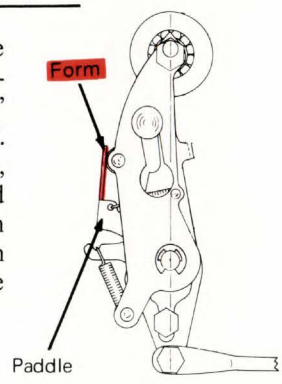
17. *Rotate Link* – Adjust the rotate link so, with an "M" half cycled, the nylon roller will drop .060" from the top of the slot. This permits maximum adjustment life of the wear compensator.



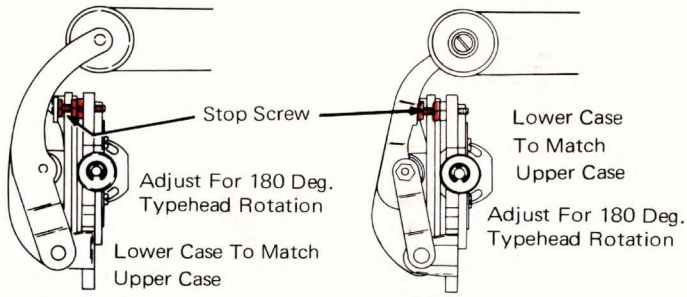
18. *Damper Spring Stop* – Adjust the damper spring stop vertically so the damper spring will be collapsed against the power frame with an "M" half cycled and the typehead removed.



19. *Ratio Change* – Form the paddle on the wear compensator assembly so the "R" detents the same as the "M". Each time the paddle is formed, the machine must be recycled (raise the roller and cycle an "M") to allow the mechanism parts to seat properly before the adjustment is checked.

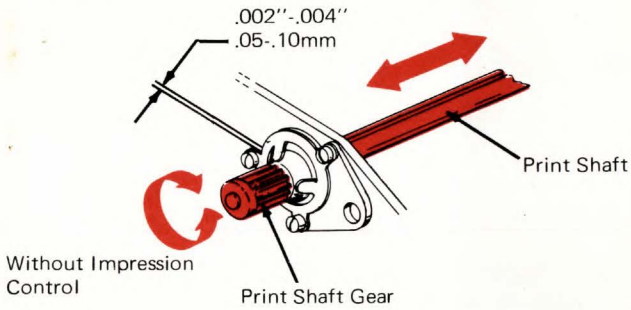


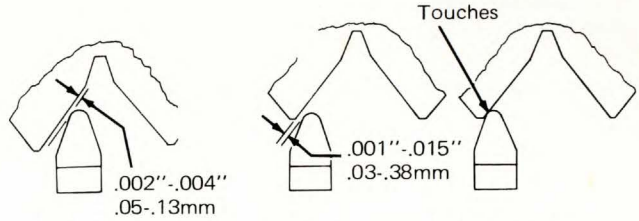
20. *Shift Motion* – Now, shift the machine into lower case so that the shift arm contacts its stop screw. Adjust the stop screw so that a lower case "t" detents *EXACTLY* the same as an upper case "T".



Stamped Shift Arm *Die Cast Shift Arm*

21. *Final Timing* – Loosen the print shaft gear and advance or retard the print shaft so that the detent enters the proper tooth with .001" - .015" clearance. Remove the headplay from the typehead as an "M" is slowly hand-cycled. You should try to favor the low side of this adjustment. Be sure to maintain .002" - .004" end play in the print shaft.





Withdrawal Level 1 *Entry* *Withdrawal Level 2*

If difficulty is encountered in obtaining the correct detent timing, check the following items:

a. Detent skirt clearance - favor the high side of the tolerance.

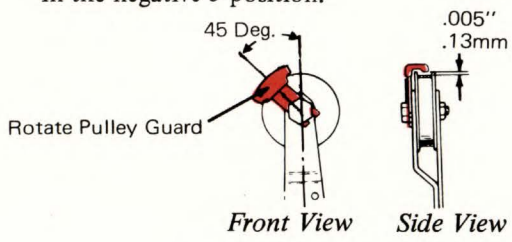
b. Typehead homing - favor the high side of the tolerance.

c. Bandwidth - make sure that it is not excessive.

d. Head play - it should be .050" - .065" measured at the typehead skirt. If excessive head play is suspected the dog bone should be replaced and the typehead homing adjustment refined.

CAUTION: Excessively advanced or retarded timing can cause parts damage as well as poor horizontal alignment or improper selection. This could happen if the detent entered the wrong notch or remained in the notch too long.

22. *Rotate Pulley Guard* – Adjust the rotate pulley guard rotationally at 45 degrees left of vertical. The guard must clear the rotate tape by .005" with the rotate arm in the negative 5 position.



23. *Final Check* – After completing the foregoing adjustments, a final check should be made to see if any refinements are necessary. Compare the detenting for the letters *WOMT*. These letters are chosen because of their rotate selections. If an excessive bandwidth exists (in excess of .015"), it will be greatest among these characters. In making the final check, follow this sequence:

EXCESSIVE BANDWIDTH

Between	Causes
"T" (zero) and "O" (-1)	Incorrect balance
"M" (-5) and "W" (+5)	Incorrect rotate arm motion
"M", "W" and "T"	Adjustments 6 and 7

If the bandwidth appears to be all right but the alignment is not satisfactory, check the following items:

Excessive play in the carrier or rocker.
Play or binds in the tilt or rotate detent.
Loose-fitting upper ball socket.
Binds in the rocker parts.

This completes the coarse alignment adjustments. The following chart may be used to determine the rotate and tilt locations of characters on typehead:

STANDARD U.S. TYPE ELEMENTS

-5	-4	-3	-2	-1	Home	+1	+2	+3	+4	+5	
[	#	&	*	$	Z	@	%	¢	)	(	T-0
X	U	D	C	L	T	N	E	K	H	B	T-1
M	V	R	A	O	°	.	"	I	S	W	T-2
G	F	:	,	?	J	+	P	Q	Y	_	T-3

Upper Case

-5	-4	-3	-2	-1	Home	+1	+2	+3	+4	+5	
]	3	7	8	4	z	2	5	6	0	9	T-0
x	u	d	c	l	t	n	e	k	h	b	T-1
m	v	r	a	o	!	.	'	j	s	w	T-2
g	f	;	,	/	¡	=	p	q	y	-	T-3

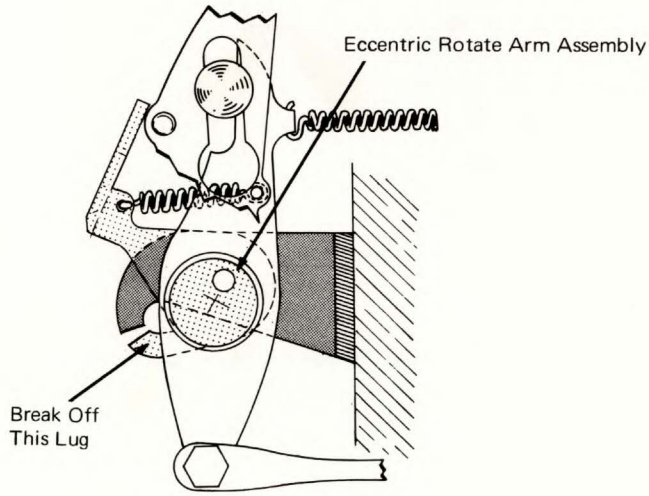
Lower Case

-5	-5, 1	-5, 2	-5, 1, 2	-5, 2, 2A	Home	1	2	1, 2	2, 2A	1, 2, 2A

PROCEDURE FOR CRIPPLING COMPENSATOR-TYPE ROTATE ARMS

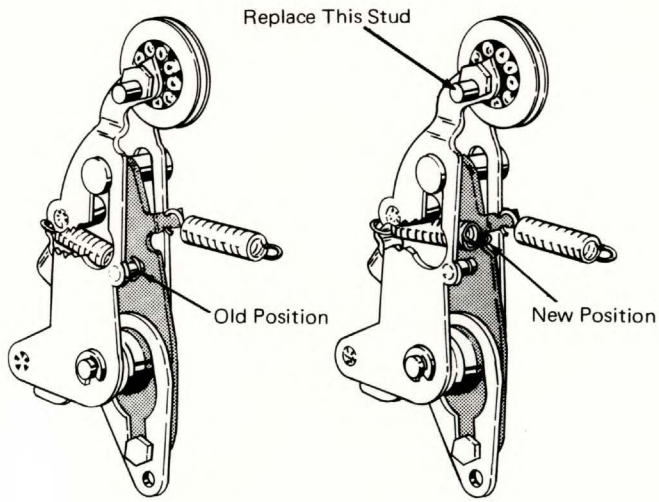
If difficulty is encountered in adjustment or operation of the compensator rotate arm, the following procedure can be used to convert it to a solid arm:

1. Break off the lug on the bottom of the eccentric rotate arm assembly.



2. Place the wear compensator wedge at the top of the slot.

3. Disconnect the spring from the rotate arm and connect it to the middle compensator arm assembly.



4. Replace the eccentric stud with the pulley stud for the solid arm, and adjust the system the same as you would adjust a solid rotate arm mechanism.

ESCAPEMENT OPERATIONAL THEORY

Escapement is the controlled single space movement of the carrier to the right that occurs every time a character is printed. The carrier is under a constant spring tension to the right. The escapement mechanism allows or prevents the carrier's movement to the right under this spring tension.

At rest, a pawl which is mounted to the carrier engages a fixed escapement rack and prevents the spring tension exerted by the mainspring from pulling the carrier to the right. During an escapement operation, the pawl is temporarily removed from the rack. (Fig. 1)

There are two pawls mounted to the carrier, an escapement pawl and a backspace pawl. There are also two racks, an escapement rack and a backspace rack.

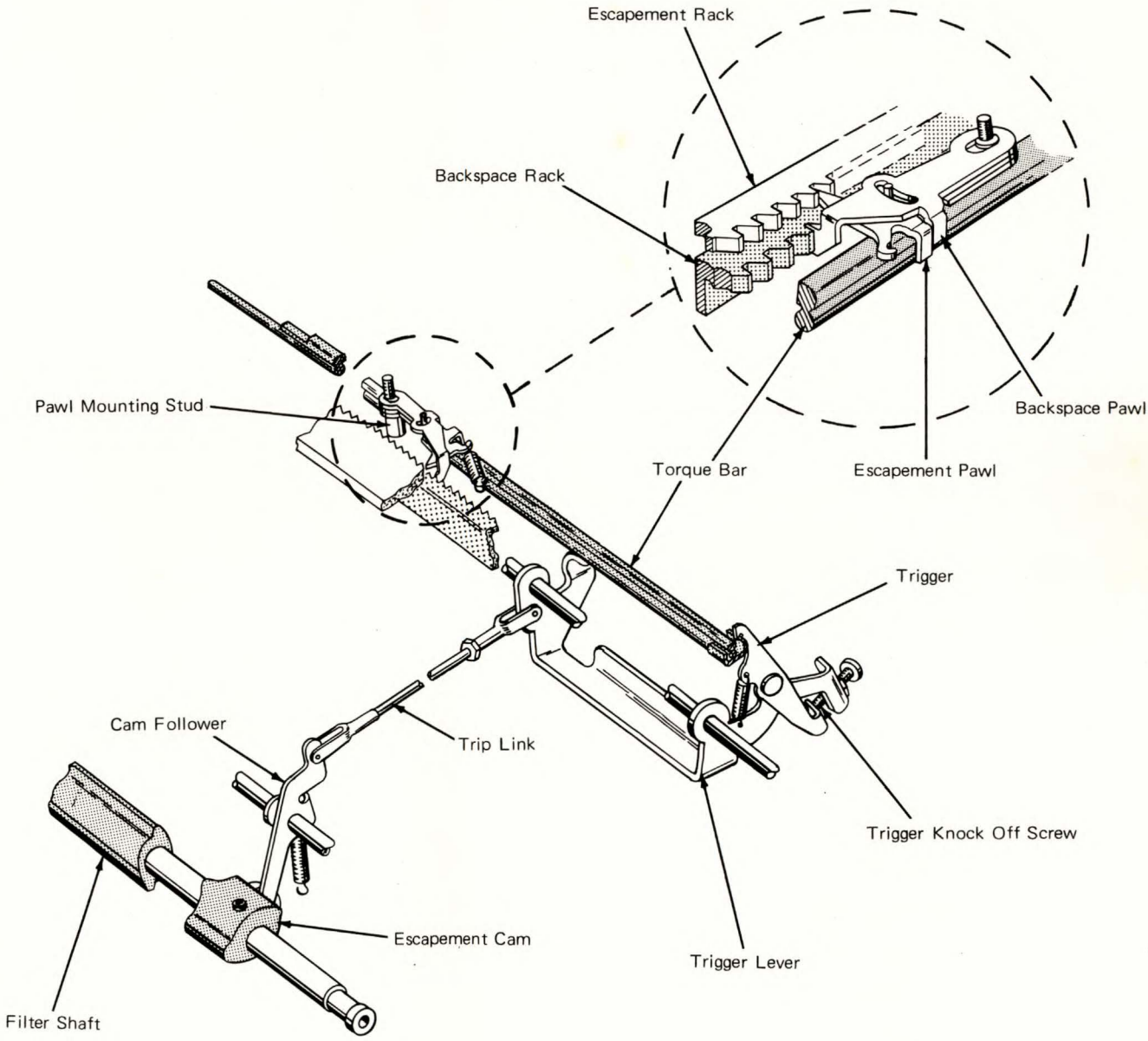


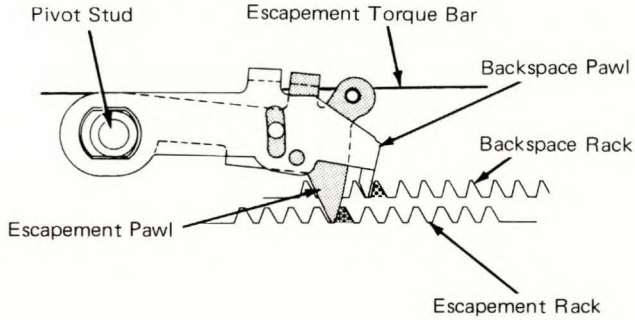
Figure 1 – Print Escapement Mechanism

An escapement operation is obtained by forcing the escapement pawl to the rear out of engagement with the rack teeth. Due to the slotted mounting hole, as soon as the pawl clears the escapement rack tooth it is snapped to the right by the pawl spring. The escapement pawl is allowed to move to the front into engagement with the next tooth. The carrier then moves to the right until it comes to rest against the escapement pawl.

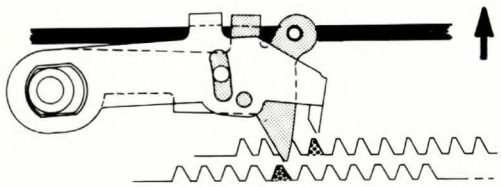
Operating Sequence

1. This picture shows the escapement and backspace pawls and their associated racks. The pivot point or stud is attached to the bracket mounted on the carrier.

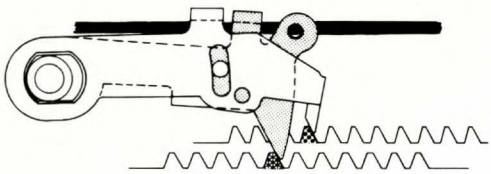
   The carrier is always being pulled to the right, and the pivot has moved to the right until it hits the right edge of the elongated slot in the pawls.



2. This picture shows the torque bar operated, the pawls have been pulled free of their racks and the spring tension has pulled the pawls to the right before the carrier has started to move.

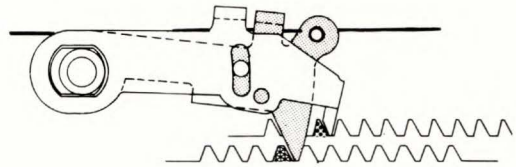


3. Here, the torque bar is returning to its rest position and the pawls are dropping into the next tooth on their racks.



4. Now the carrier has moved to the right and the pawls have stopped the stud, and again the carrier is at rest after spacing once.

   There is a timing consideration in this type of escapement. The torque bar must return to rest before the carrier has moved enough to skip a tooth on the racks.



The carrier and escapement pawl must be moved to the left for a backspace operation. Because the backspace pawl is mounted to the escapement bracket, movement of the backspace pawl to the left forces the carrier and escapement pawl to the left. The backspace pawl is mounted just above the escapement pawl, but its tooth extends below the escapement pawl and is held engaged with the backspace rack by a small extension spring.

The backspace rack is mounted to the rear of the power frame by shouldered screws through elongated holes in the rack. This mounting arrangement allows lateral movement of the rack. Movement of the rack towards the left forces the backspace pawl to the left to cause a backspace operation.

The backspace operation is pointed out here due to its close association with the escapement mechanism. The backspace pawl is engaged with the rack when in the rest position. This means that both the backspace and escapement pawls must be removed from their racks in order for the carrier to move to the right.

A flat torque bar pivots between the sides of the power frame just to the rear of the backspace and escapement racks. Its purpose is to trip the backspace and escapement pawls out of their respective racks. (Fig. 2)

The pivot point of the torque bar is near its bottom edge. The escapement pawl and the backspace pawl each have a lug that extends down just behind the torque bar. As the top of the torque bar pivots to the rear, it will force the lugs of the pawls to the rear causing the tips of the pawls to clear their respective racks.

Rotation of the escapement torque bar is instantaneous and supplies just enough motion to remove the pawls from their racks. The torque bar is immediately rotated back to the rest position by an extension spring located at the right hand end. This allows the pawls to re-enter their racks to limit the carrier movement to one space.

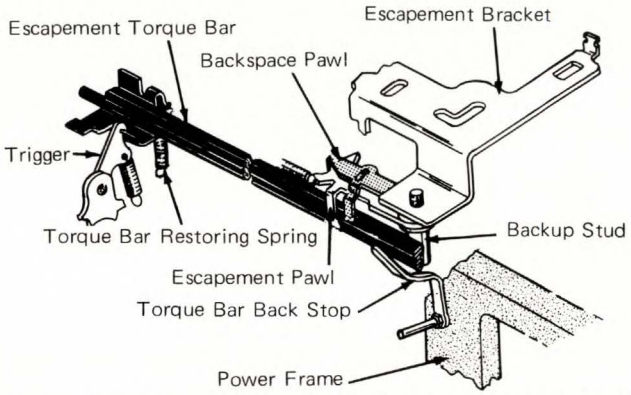


Figure 2 – Escap. Torque Bar Backstop and Backup Stud

Because of the force required to trip the pawls out of their racks, the torque bar tends to bow toward the front instead of pushing the pawls to the rear. This is eliminated by a large head on the pawl pivot stud extending down from the escapement bracket directly in front of the torque bar. On long carriage machines, an additional support is given to the escapement torque bar to prevent it from bowing to the rear. A backstop mounted to a stud in the machine power frame provides the backing.

The escapement trigger is used to operate the torque bar to obtain an escapement operation. A lug on the right rear end of the torque bar is used to pivot the torque bar. Downward movement of the trigger causes the torque bar to rotate. (Fig. 3)

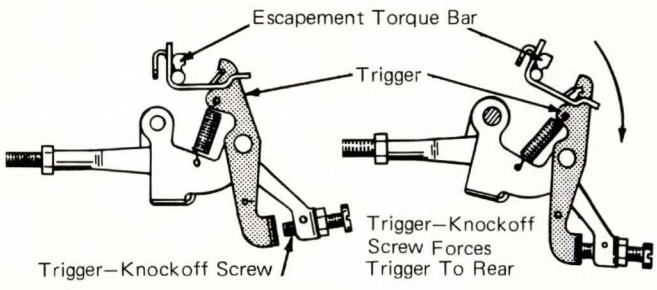


Figure 3 – Escapement Trigger Operation

The trigger lever is cam operated, therefore, it can only restore as fast as the cam can rotate from the high point to the low point. To prevent the escapement pawl from skipping, the torque bar must be allowed to restore more quickly. An adjustable knockoff screw causes the trigger to cam off of the torque bar lug just after the pawls have been removed from the rack. The torque bar can then restore without waiting for restoration of the trigger and the trigger lever.

Power to operate the escapement trigger is taken from a double lobed cam mounted on the filter shaft just inside the right hand power frame. Each time a cycle operation occurs, the filter shaft operates the cam 180 deg. Anytime the escapement and backspace pawls are removed from their racks, the carrier is pulled toward the right by the mainspring tension. (Fig. 4)

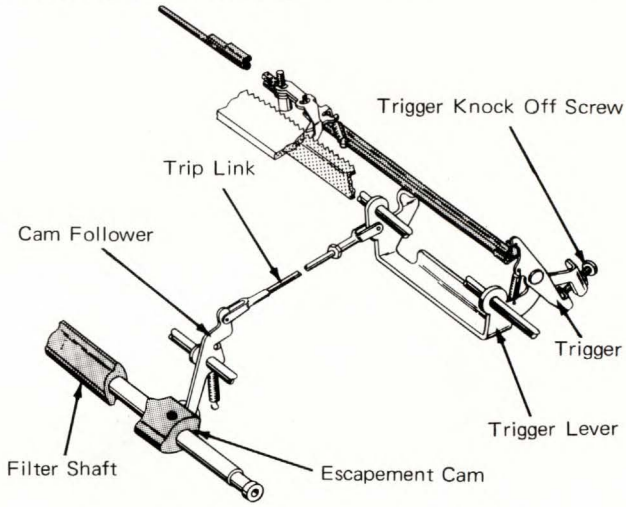


Figure 4 – Print Escapement Mechanism

The escapement shaft extends forward through a backplate and the power frame. Located on this shaft are two drums. Attached to each drum is a small nylon cord. The escapement/tab cord is wound several turns around the front drum, then to the right over a guide roller just prior to passing through the right side of the machine. The cord passes around a cord tension arm and back through the power frame and connects to the right hand side of the carrier. (Fig. 5)

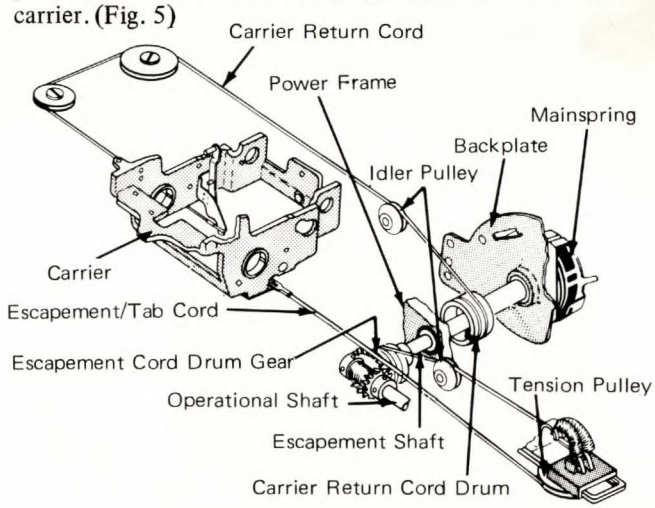
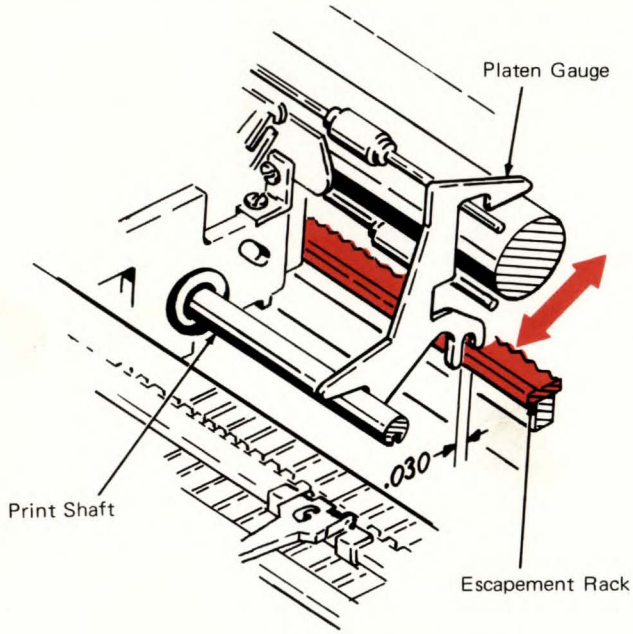


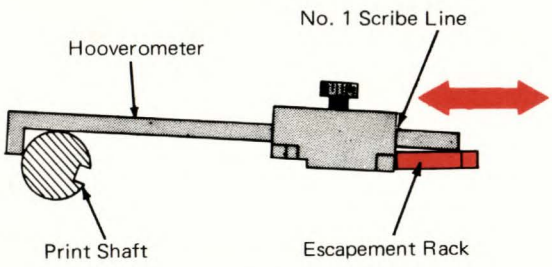
Figure 5 – Mainspring and Cords System

Another cord is wound around the drum between the power frame and the backplate. Through a guide and pulleys, the cord is attached to the left hand side of the carrier. This cord is used for carrier return. The carrier return cord must pay out cord in order for the carrier to move to the right. Likewise the escapement tab cord must be payed out from its drum in order for the carrier to return to the left. To accomplish this, the cords are wound in opposite direction.

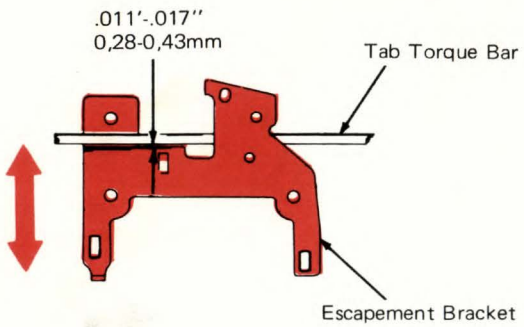
ESCAPEMENT ADJUSTMENTS

1. *Escapement Rack* – With the print shaft rotated so the keyway is down, position the platen gage to rest on the print shaft and the escapement rack. The correct position of the escapement rack is the distance spanned by the gage plus .030". Adjust the escapement rack to this dimension and parallel to the print shaft. If the platen gage is not available, the escapement rack positon may be set from the No. 1 scribe line on the hooverometer. It should just span the distance from the print shaft.

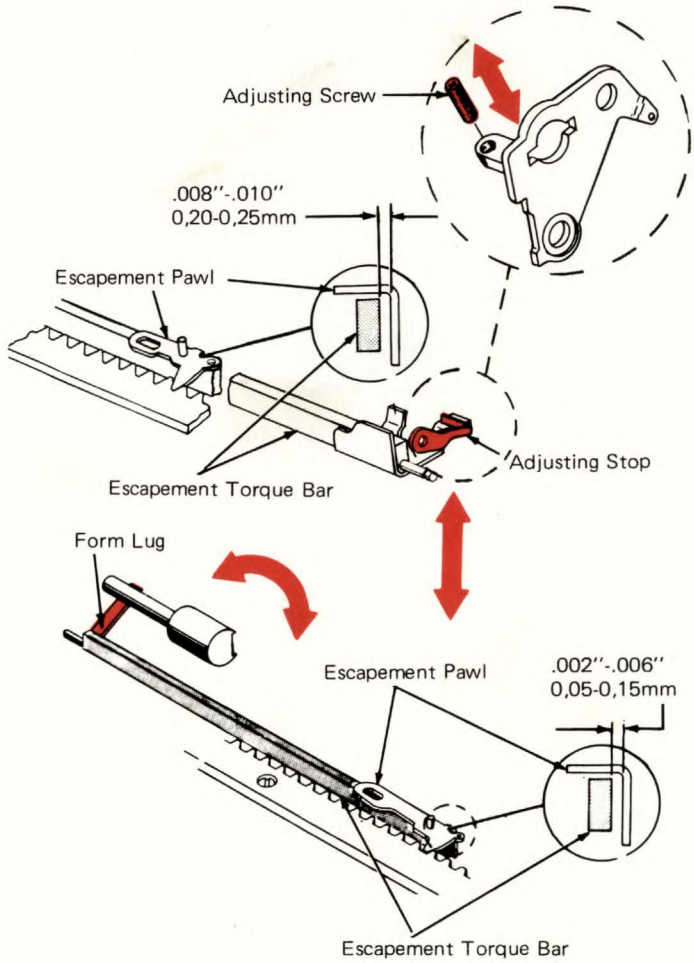




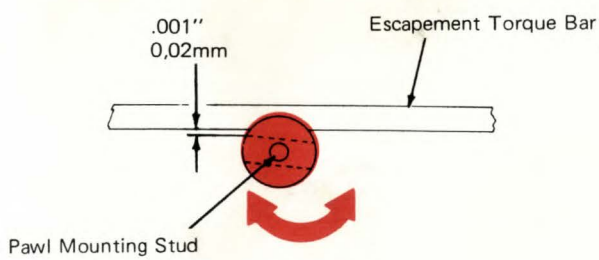
2. *Escapement Bracket* – Position the escapement bracket to parallel the tab torque bar with .011" - .017" clearance. Be sure this clearance is not observed at the boss on the escapement bracket.



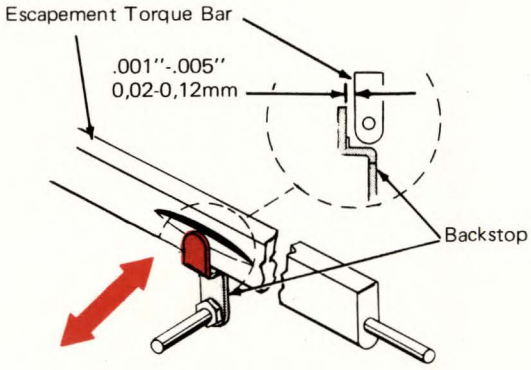
3. *Escapement Torque Bar Stop* – Adjust the escapement torque bar stop to obtain .008" - .010" clearance between the rear of the torque bar and the lug on the escapement pawl with all parts at rest. Machines equipped with a form lug on the left hand end of the escapement torque bar should be adjusted for .002" - .006" clearance between the rear of the torque bar and the lug on the escapement pawl with all parts at rest.



4. *Pawl Mounting Stud* – Adjust the pawl mounting stud rotationally to obtain .001" clearance between the mounting stud and the front of the escapement torque bar. Keep the eccentric in the left half of its orbit.

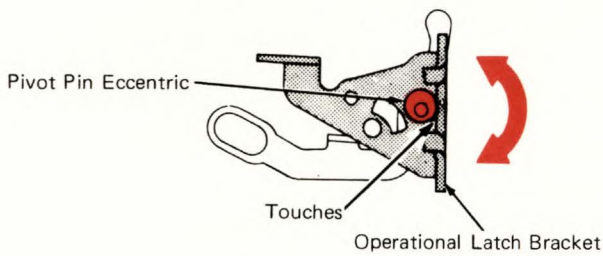


5. *Torque Bar Backstop (7X3–7X5)* – Form the backstop front to rear to obtain .001" - .005" clearance between the stop and the rear of the torque bar.



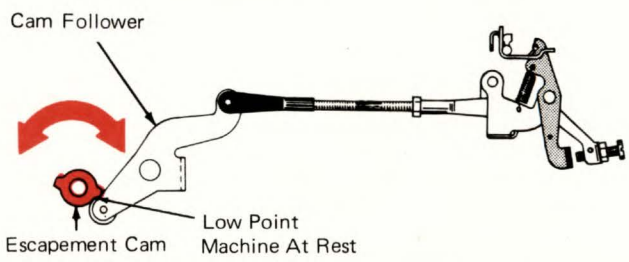
6. *Pivot Pin Eccentric (Early Level Machine Only)* – The eccentric collar should be adjusted with the high point up so that it touches the operational latch bracket. This prevents the pivot pin from bowing during a print escapement operation. On long carriage machines, the eccentric should also be adjusted laterally on the pivot pin to maintain an end play of the pivot pin of .002" - .005".

Note: The eccentric may require readjustment if the rest position of the pivot pin is changed during carrier return adjustments.

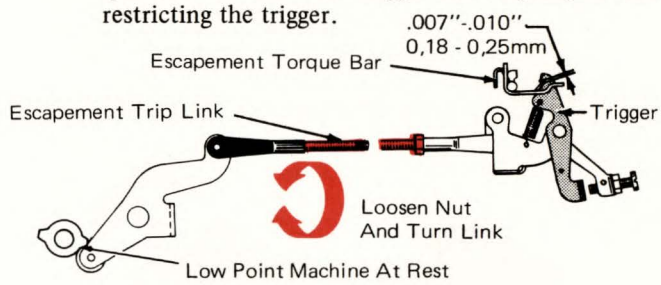


7. *Escapement Cam* – With the machine at rest, adjust the cam radially on the filter shaft so the cam follower roller is resting at the start of the low dwell.

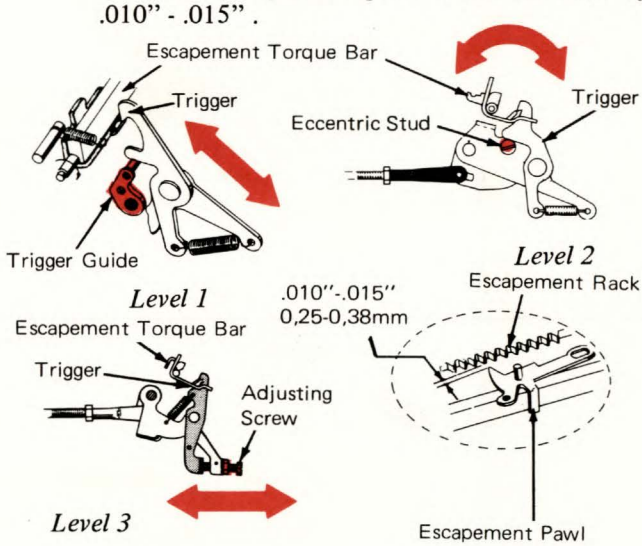
On machines equipped with the old-style spacebar lockout mechanism, the lockout cam adjustment must be checked each time the escapement cam adjustment is changed. Advancing or retarding the escapement cam could allow the lockout cam to disable the spacebar mechanism.



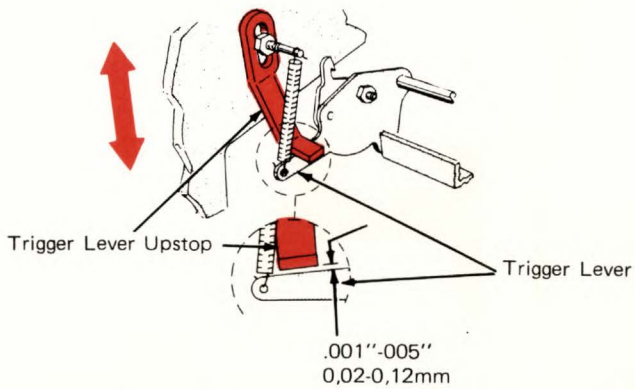
8. *Escapement Trip Link* – With the machine latched at rest, adjust the escapement trip link to obtain .007" - .010" clearance between the hook on the trigger and the extension on the escapement torque bar. Be sure the trigger lever upstop is not restricting the trigger.



9. *Trigger Knockoff* – Adjust the trigger guide (level 1), the trigger knockoff eccentric stud (level 2), or the knockoff adjusting screw (level 3) so the escapement trigger will cam off the torque bar lug when the escapement pawl clears the rack by .010" - .015".

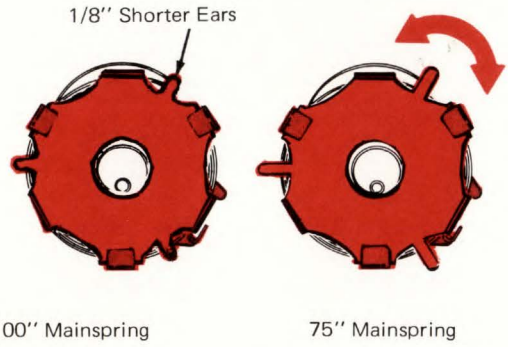


10. *Trigger Lever Upstop (7X3–7X5)* – With all parts at rest, adjust the trigger lever upstop vertically to obtain. .001" - .005" clearance between the upstop and the trigger lever.

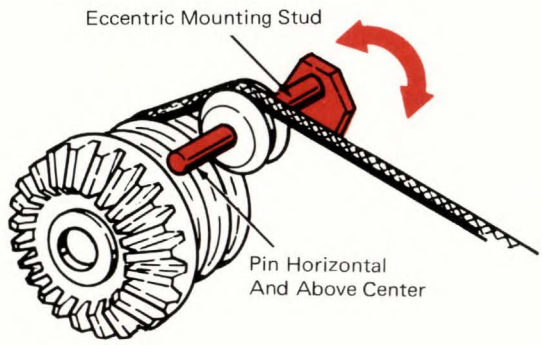


11. *Mainspring Tension* – With the carrier resting at the extreme right hand margin, wind the short eared mainspring seven turns. The long eared mainspring should be wound five turns.

CAUTION: The mainspring should be handled with care to prevent it from slipping when the tension is being increased or decreased.



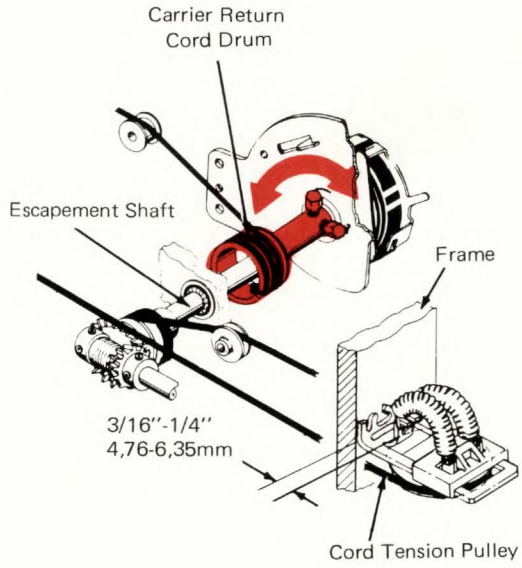
12. *Idler Pulley Eccentric* – The eccentric mounting stud for the front idler pulley should be set so that the pin is horizontal and above center on the eccentric. The pin will then be angled toward the left slightly.



13. *Cord Tension* – With the cords properly threaded, adjust the carrier return cord drum so that the inner flange of the cord tension pulley is 3/16" to 1/4" from the powerframe.

The position of the pulley ensures that it will not contact the cover as it compensates for the cord stretch. Adjusting the pulley nearer the powerframe puts an unnecessary load on the cords.

CAUTION: Be sure to remove all end play from the escapement shaft before tightening the carrier return cord drum. End play is removed by holding the escapement shaft forward while the cord drum is moved to the rear against the rear bearing.



Because of the interrelated functions of the spacebar and operational control mechanisms they will be covered together in this section.

The spacebar is mounted at the front of the keyboard on a pivot shaft. Depression of the spacebar causes the pivot shaft to rotate, and in turn the spacebar keylever. As the spacebar keylever is depressed, a lower lug on the keylever pawl contacts the interposer, forcing it down to release the interposer latch from the latching surface of the interposer latch plate. As soon as the interposer latch has cleared the latch plate, the interposer is pulled to the rear by its spring. (Fig. 1)

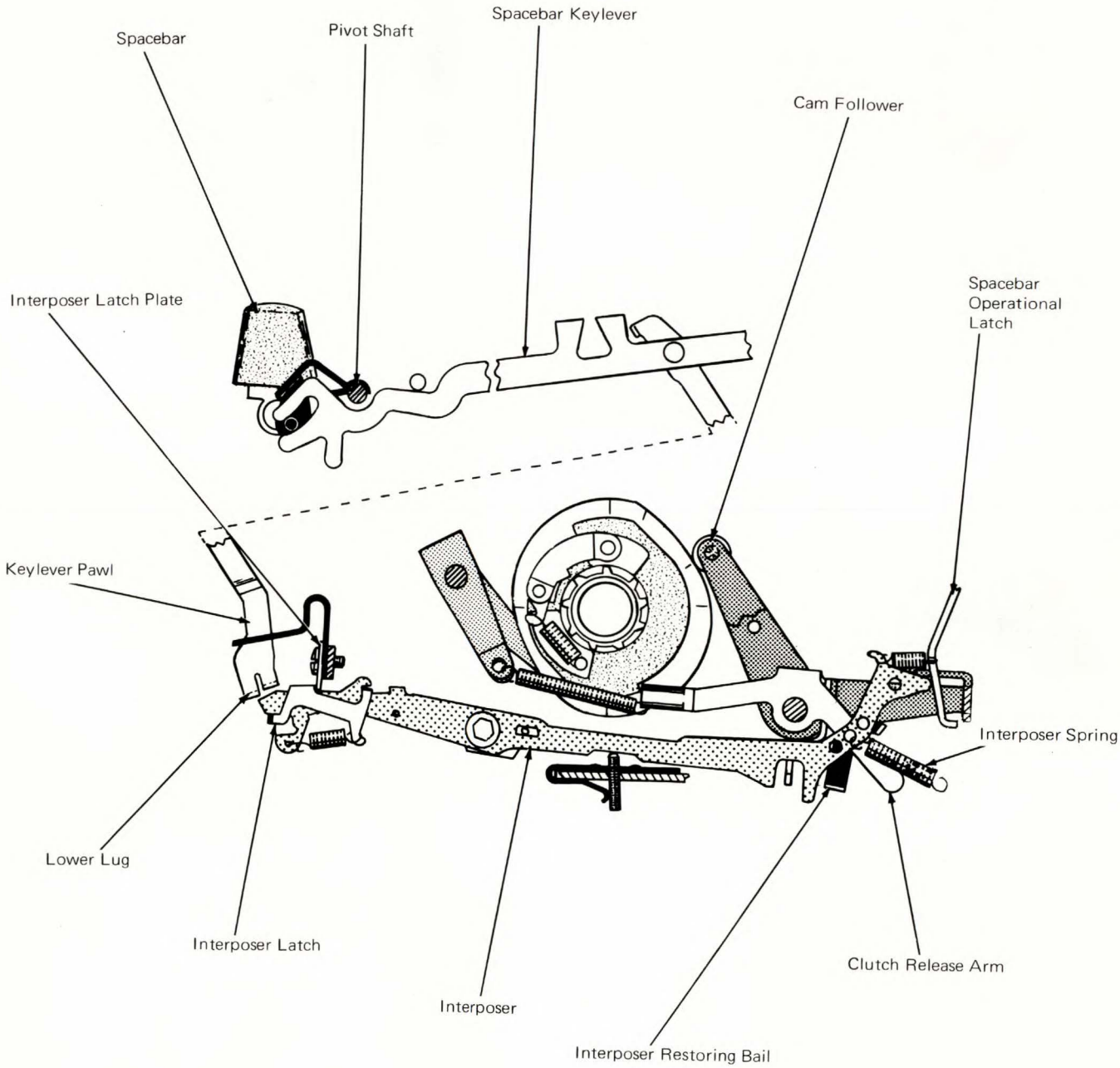


Figure 1 – Operational Control And Spacebar Mechanisms

A lug on the interposer contacts the clutch release arm, rotating it down at the front allowing the cam wheel to be released. This allows the spring-loaded cam pawl to move into a position to be contacted by the rotating operational clutch ratchet which is setscrewed to the operational shaft. At the same time, the interposer forces the spacebar latch to the rear, pushing it under the cam follower. (Fig. 2)

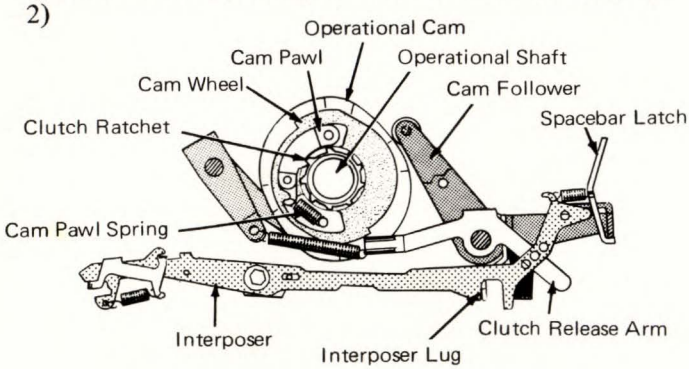


Figure 2 – Operational Clutch Release Mechanism

As the cam is driven by the clutch ratchet, the cam follower moves from the low dwell to the high point of the cam. Movement of the cam follower pulls the spacebar operational latch down which causes the spacebar latch lever to pivot. An adjusting screw on the latch lever contacts the trigger lever, causing the trigger lever to rotate about its pivot pin. This causes the trigger on the trigger lever to rotate the escapement torque bar and allow the carrier to complete an escapement operation in the same manner as a character print escapement. (Fig. 3)

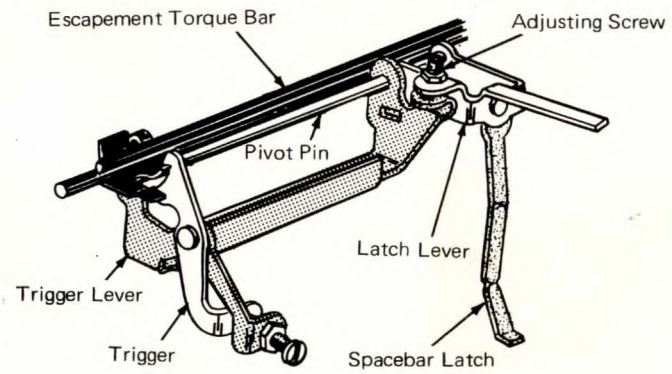


Figure 3 – Spacebar Latch And Trigger Lever Mechanism

As the cam follower is pulling down on the spacebar latch, it also actuates the interposer restoring lever to restore the interposer forward. The clutch release arm restores into the path of the clutch wheel ready to disengage the cam clutch. (Fig. 4)

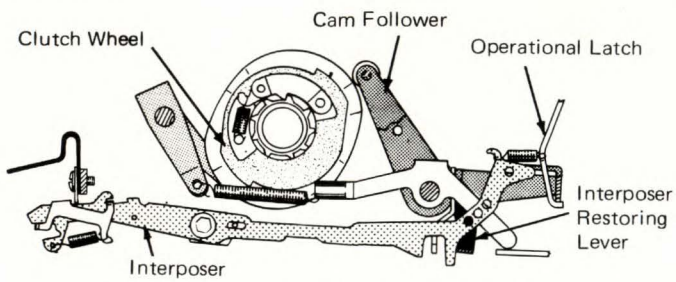


Figure 4 – Interposer Restoring Operation

The rotational movement of the cam wheel is stopped when its tooth contacts the clutch release arm. (Fig. 5) Continued movement of the operational cam while the cam wheel is held stationary causes a pin on the cam pawl to slide up the beveled hole in the clutch wheel and disengage the pawl from the ratchet. To hold the cam in the disengaged position, a check pawl is provided. The check pawl engages a notch in the cam check ring. (Fig. 6)

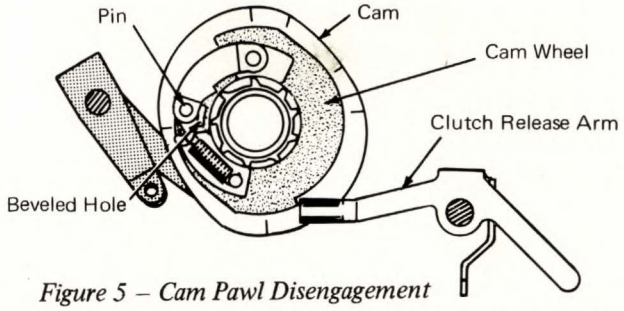


Figure 5 – Cam Pawl Disengagement

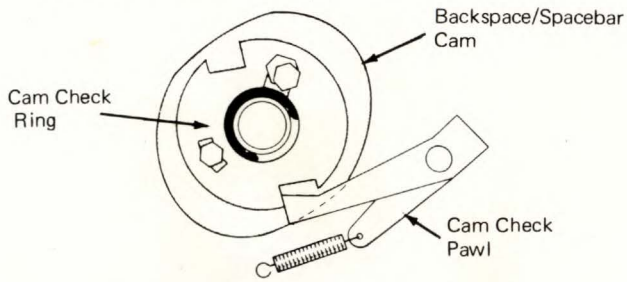


Figure 6 – Cam Check Pawl

Repeat operation of an operational mechanism can be accomplished by preventing the interposer from relatching against the interposer latch plate. (Fig. 7) A second lug, called the repeat lug, on the keylever pawl is used to prevent the relatching of the interposer when a keylever is depressed in the repeat zone. In the case of Carrier Return the repeat lug on the keylever pawl, is formed to the right above the index interposer. Depression of the carrier return keylever into the repeat zone causes the index interposer to be released, resulting in additional line-spacing.

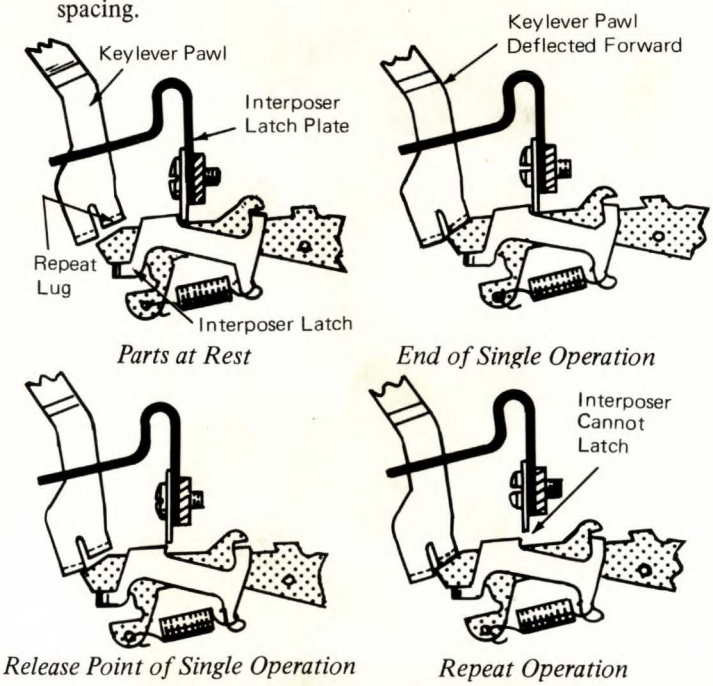


Figure 7 – Keylever Pawl Operation

As previously mentioned, both spacebar escapement and print escapement operate by actuating the escapement trigger lever to cause an escapement operation. Because of the inter-relationship of these two mechanisms operating both of them rapidly or together causes only one space of escapement to occur. This could happen when an operator strikes the spacebar too soon after a character print operation.

To ensure the spacebar will actuate an escapement operation following a print cycle, it is necessary to place the spacebar mechanism into storage until the print cycle is completed. (Fig. 8)

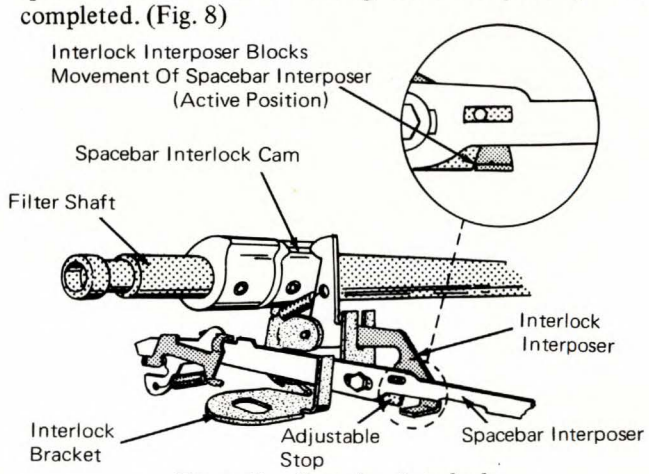


Figure 8 – Spacebar Interlock

Spacebar storage is accomplished by blocking the movement of the spacebar interposer to the rear. As the filter shaft rotates during a print operation, the interlock interposer follows the contour of the spacebar interlock cam by pivoting the top to the front. As the interlock interposer drops off of the high point of the cam, its rear extension moves up and blocks the movement of the interposer to the rear. This stops the spacebar operation and holds the interposer in "storage" until the print cycle is completed.

On early machines spacebar storage is accomplished in the following manner. A lockout cam is spring-loaded toward the right against the escapement cam. In the rest position, the lockout cam is held to the left by the lateral camming surfaces of the two cams. In this position, the spacebar interposer is free to operate without interference. (Fig. 9)

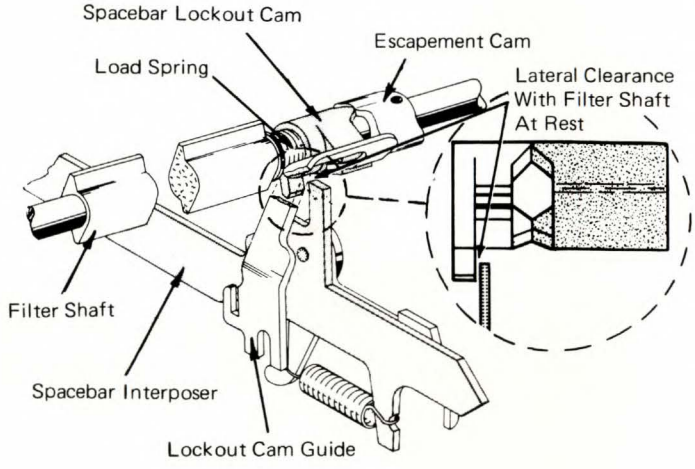


Figure 9 – Early Spacebar Interlock (At Rest)

During a character cycle, rotation of the filter shaft allows the lockout cam to move toward the right because the high points of the lateral camming surfaces are no longer in contact. The lockout cam is prevented from rotating with the filter shaft by a guide bracket that fits in a slot in the front of the cam. As the lockout cam slides to the right, an extension at the bottom of the cam moves into the path of a lug on the spacebar interposer. As the filter shaft approaches its rest position, the lockout cam is forced back to the left by the escapement cam. The spacebar interposer is then released and normal spacebar operations can occur. (Fig. 10)

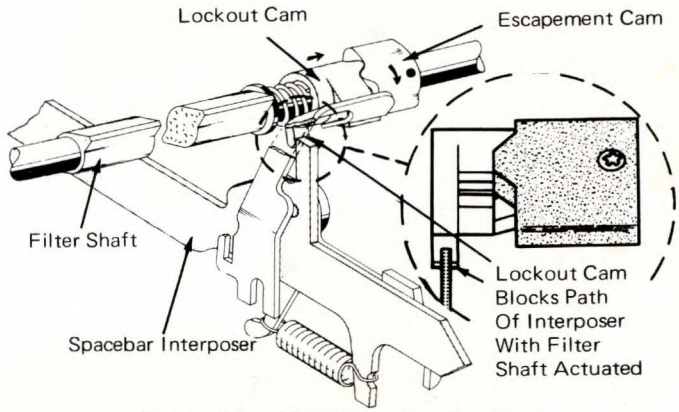


Figure 10 – Early Spacebar Interlock (Lockout Actuated)

In addition to powering the spacebar mechanism, the operational control mechanism is also used during backspace, carrier return and index operations.

Two cams provide the necessary motion to operate these mechanisms. The left hand operational cam is a double lobed cam and provides the motion to drive the spacebar and backspace mechanisms. The right hand cam is single lobed and powers the carrier return and index mechanisms. (Fig. 11)

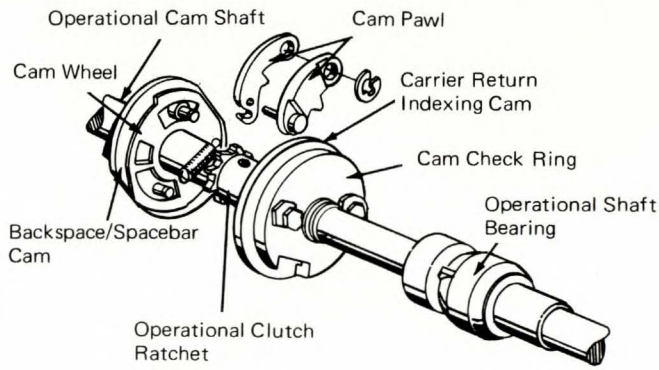
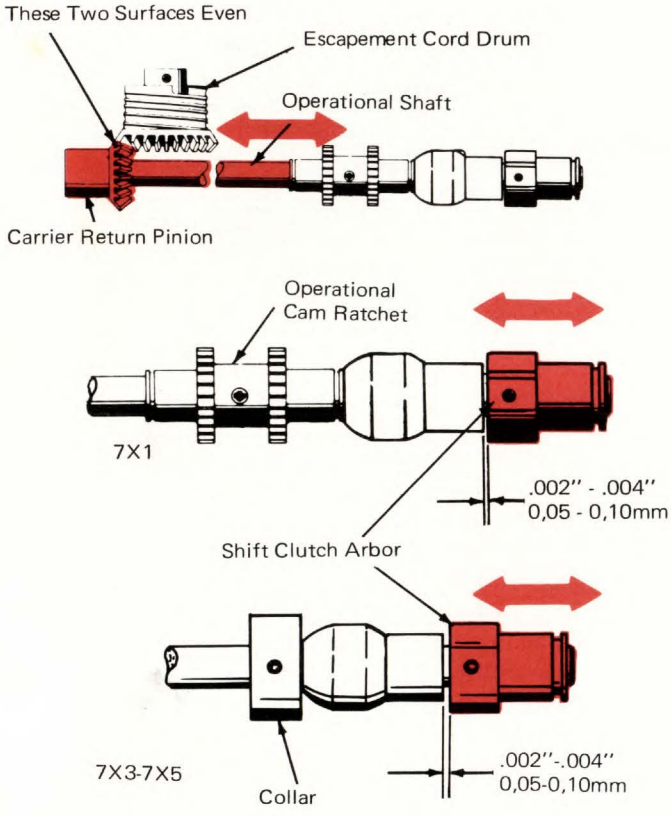


Figure 11 – Operational Cam Assembly

There is an interposer in the operational control mechanism for each of the four functions (Spacebar, Backspace, Carrier Return and Index) driven by that mechanism.

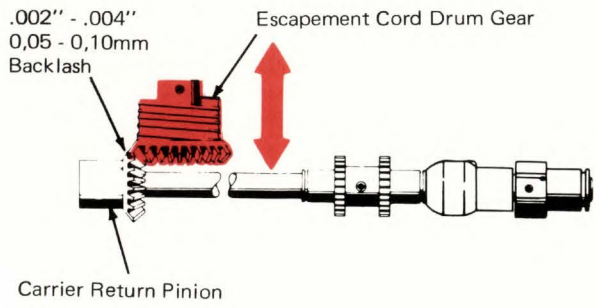
The principles of operation for both operational cams and the entire operational control mechanism is the same. The backspace, carrier return and index mechanism theory is very similar to the spacebar mechanism, although the parts design may differ slightly.

1. *Operational Shaft Position And End Play* – Position the operational shaft laterally so the crown surfaces of the escapement cord drum and the carrier return pinion are even while maintaining .002"-.004" end play of the operational shaft. On the Model 7X1 this adjustment is controlled by the operational cam ratchet and the shift clutch arbor. On longer machines, the position is controlled by a collar screwed to the operational shaft and the shift clutch arbor.

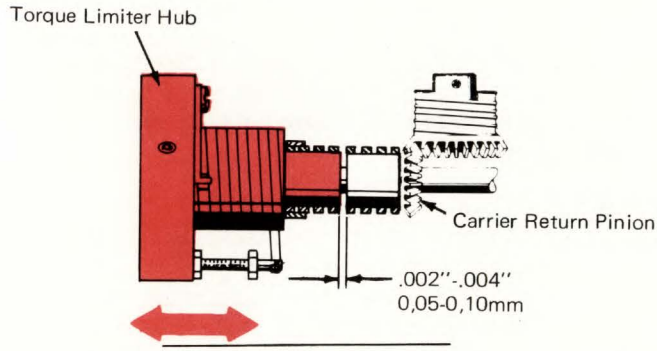


2. *Carrier Return Pinion Backlash* – Adjust the escapement cord drum gear front to rear to obtain .002"-.004" backlash between the carrier return pinion and the escapement cord drum gear.

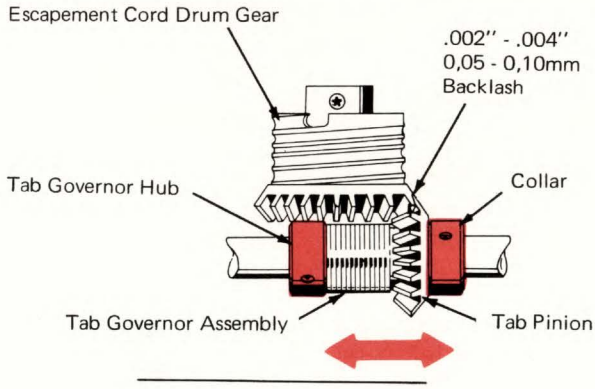
NOTE: Recheck adjustment No. 1 after making this adjustment.



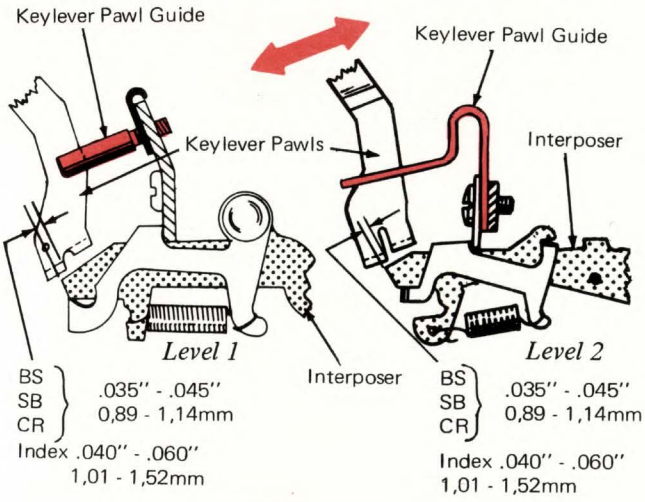
3. *Carrier Return Pinion Side Play* – Adjust the torque limiter hub left or right so there is .002"-.004" clearance between the carrier return pinion and the torque limiter arbor.



4. *Tab Pinion Backlash* – Adjust the tab governor assembly left or right to obtain .002"-.004" backlash between the tab pinion and the escapement cord drum gear. The pinion should have a minimum of end play between the tab governor hub and collar yet still rotate freely.



5. *Keylever Pawl Overlap* – Adjust each keylever pawl guide so the keylever pawls overlap their respective interposers by .035"-.045" with both parts at rest. The index keylever pawl guide should be adjusted for .040"-.060" overlap. This overlap ensures proper repeat/non-repeat operation.

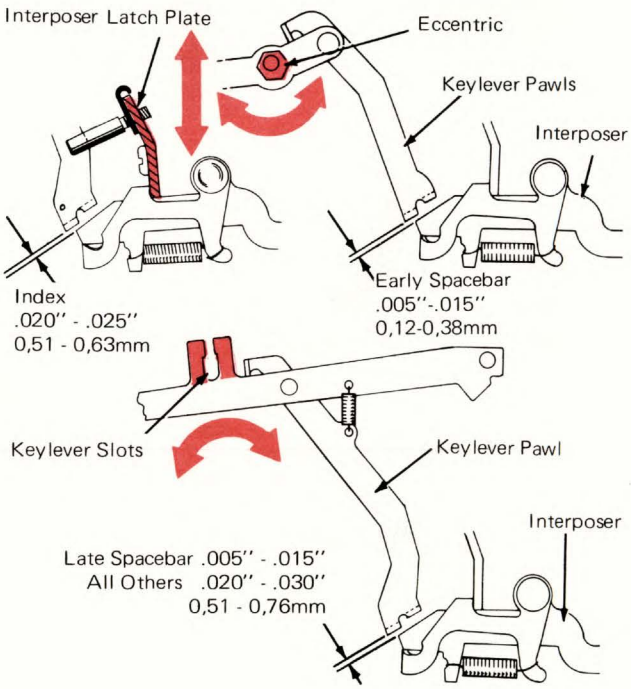


6. *Keylever Pawl To Interposer Clearance* – Adjust the keylever pawls up and down to obtain the following clearances:

Adjust the interposer latch plate for .020"-.025" between the index keylever pawl and its interposer.

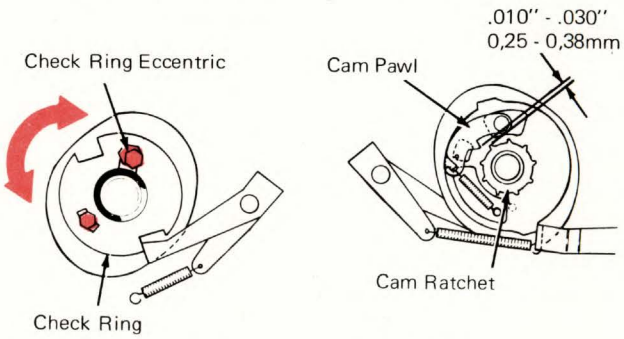
Adjust the eccentric on the spacebar keylever mounting stud, on early machines, and the adjusting slots on late level machines for .005"-.015" clearance between the keylever pawl and the spacebar interposer.

Adjust the keylever slots for a clearance of .020"-.030" between the backspace and carrier return keylever pawls and their interposers.

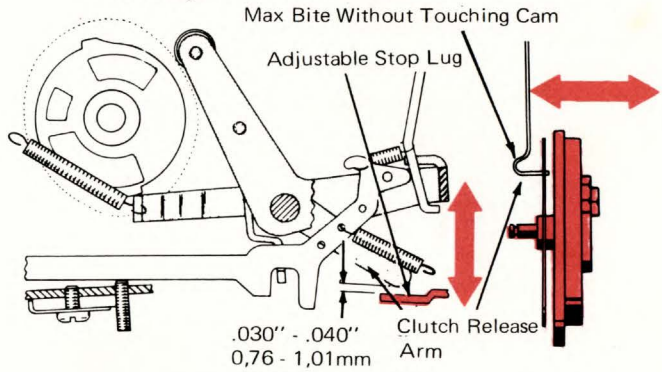


7. *Operational Cam Check Ring* – Adjust the operational cam check ring eccentric so that .010"-.030" exists between the tip of the cam pawl and the teeth of the operational cam ratchet with the cam latched in the rest position.

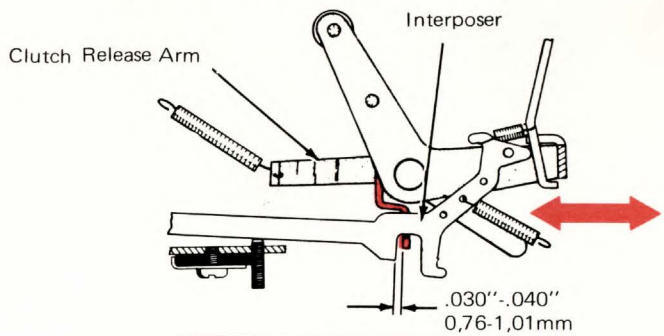
NOTE: Both the check ring mounting studs must be loosened before making this adjustment.



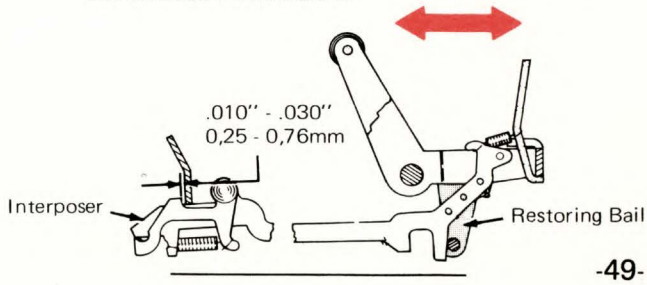
8. *Clutch Release Arm Bite* – Form the adjustable stop lugs on the operational control bracket so each clutch release arm engages its clutch wheel by .030"-.040". This adjustment may be observed by measuring the amount of clearance that exists between the stop lugs and the lower extension of each clutch release arm when the release arm has released the clutch wheel and is resting against the high portion of the clutch wheel tooth. On longer machines (7X3 and 7X5), the operational cam assembly should be positioned left to right so that the clutch release arm for both the single and double lobed cams will take an equal lateral bite on its respective clutch wheel.



9. *Clutch Release Arms* – With the operational interposers and operational cams in their rest position, form the lug at the bottom of each clutch release arm so it clears the operational interposer lugs by .030"-.040". This adjustment ensures the proper timing of the operational cam in relationship to the rest of the mechanism.

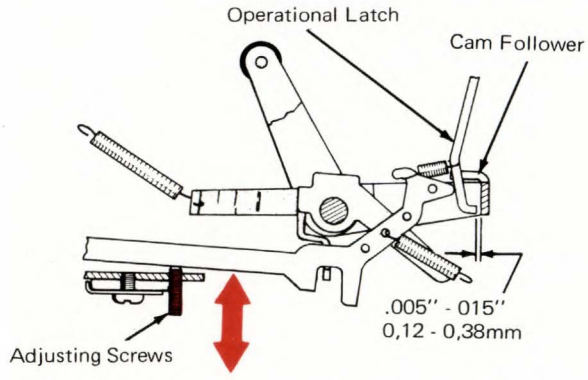


10. *Interposer Restoring Bail* – Form the lug at each side of the restoring bail so the interposers will be restored forward .010"-.030" past their latching point when either cam is operated. The lugs should be formed forward or back to obtain this adjustment. Forming the lugs forward increases the throw of the interposers. This adjustment ensures positive relatching of the interposers without excessive overthrow.



11. *Interposer Adjusting Screws* – Adjust the four interposer adjusting screws so a front to rear clearance of .005"-.015" exists between all the operational latches and their respective cam followers.

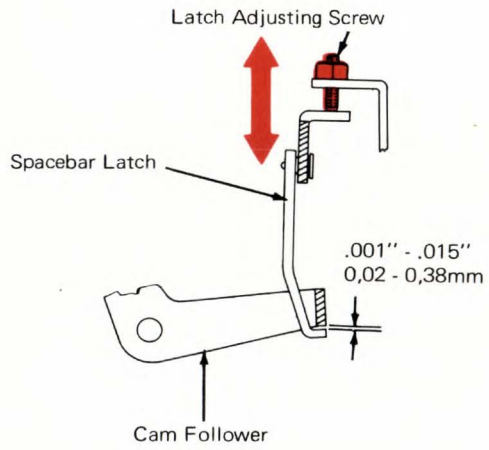
This adjustment may be checked by operating the operational cams enough to move the cam followers down slightly at the rear. With the machine on its back, the latches can be pushed against the cam followers to estimate the clearance.



NOTE: Due to the relationship between this adjustment and the operational latch height adjustment of the Backspace, Carrier Return and Spacebar mechanisms, this adjustment must be rechecked after making the latch height adjustment.

The following adjustments are for the spacebar mechanism only.

12. *Operational Latch Height* – Adjust the latch adjusting screw so the spacebar latch will pass under the cam follower with a clearance of .001"-.015".



NOTE: This clearance can be observed by pulling the latch to the rear with a spring hook while the machine is at rest.

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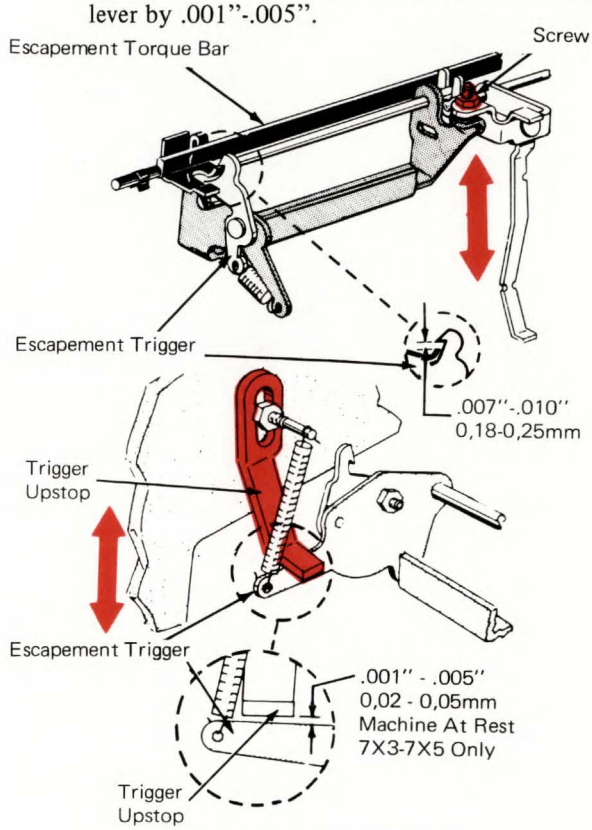
13. *Spacebar Latch Lever Screw* – Adjust the screw so that .007"-.010" clearance exists between the escapement trigger and the escapement torque bar. Disconnect the escapement trip link before making this adjustment. On long carriage machines (7X3 and 7X5), the trigger upstop should be moved up out of the way when making this adjustment. After completing the adjustment, the upstop should be readjusted so it clears the trigger lever by .001"-.005".



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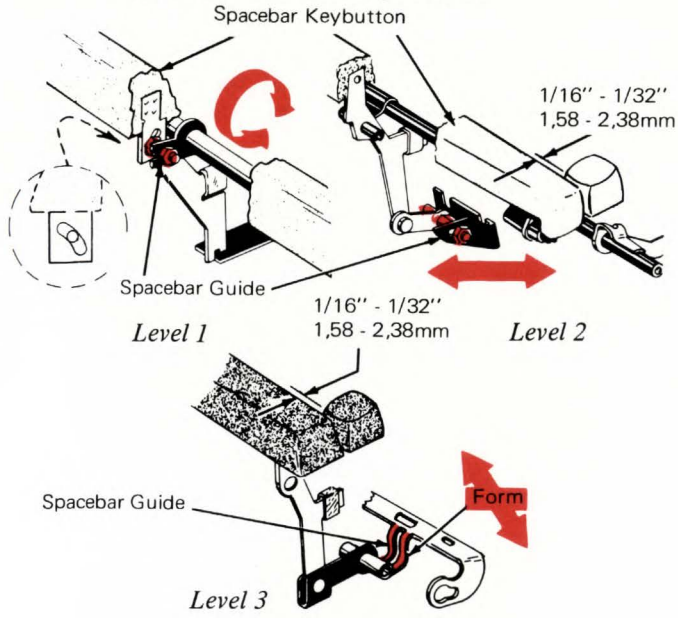
14. *Spacebar Guide* – Adjust the spacebar guide for free up and down travel of the spacebar keybutton and for 1/16"-1/32" between the rear edge of the spacebar keybutton and the front edge of the fourth row character keybuttons.



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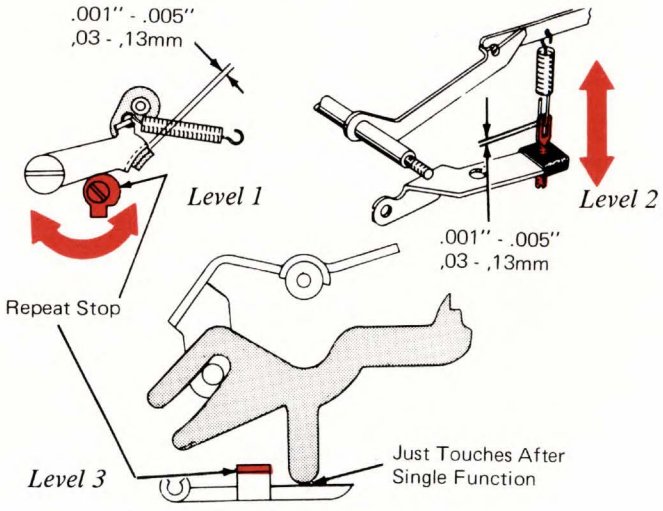
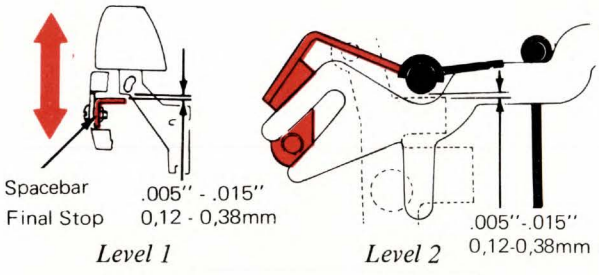
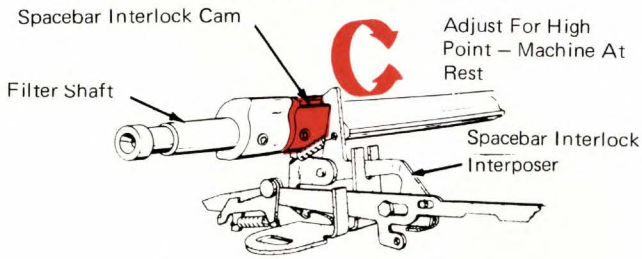
15. *Spacebar Repeat Stop* – Adjust the spacebar repeat stop so that the additional load of the repeat stop is applied to the spacebar just after a single operation occurs.



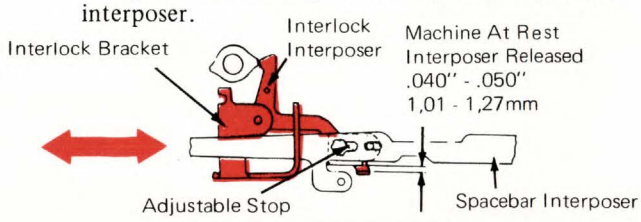
16. *Spacebar Final Stop* – Adjust the spacebar final stop to obtain .005"-.015" clearance between the stop and the spacebar stem at the time a repeat operation occurs.



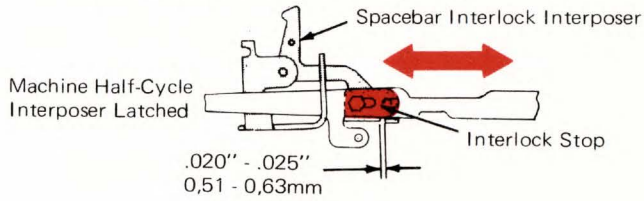
17. *Spacebar Interlock Cam* – Adjust the spacebar interlock cam radially on the filter shaft so that when the machine is at rest the spacebar interlock interposer is on the high point of the cam.



18. *Spacebar Interlock Bracket* – With the machine at rest and the spacebar interposer released, adjust the interlock bracket front to rear to obtain a clearance of .040"-.050" between the interlock interposer and the adjustable stop on the spacebar interposer.

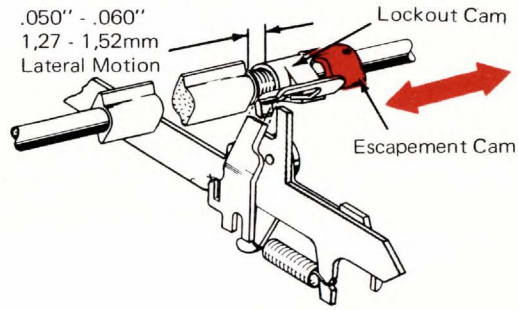


19. *Interlock Stop* – With the machine half cycled and the spacebar interposer latched at rest, adjust the spacebar interposer interlock stop so there is .020"-.025" between the interlock stop and the spacebar interlock interposer.

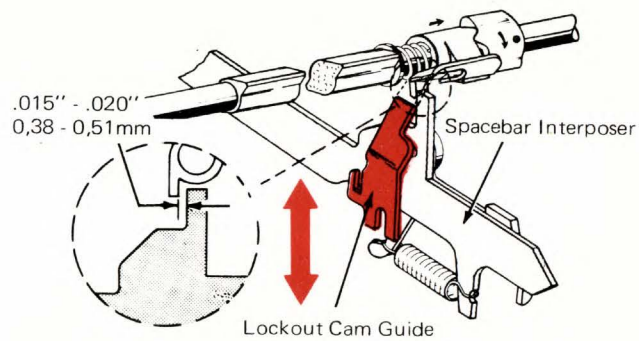


20. *Lockout Cam* (Old style interlock mechanism only) – With the lockout cam on the high point of the escapement cam, adjust the escapement cam laterally so the lockout cam will have .050'.-.060" remaining movement available toward the left.

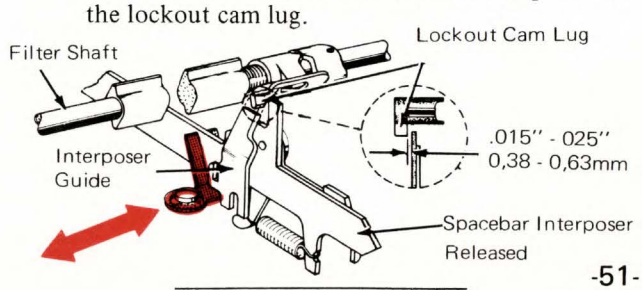
NOTE: Be sure to maintain the proper radial adjustment of the escapement cam.



21. *Lockout Cam Guide* – With a character half-cycled, adjust the lockout cam guide up or down so the spacebar interposer will move to the rear .015"-.020" when it is unlatched.



22. *Spacebar Interposer Guide* – With the filter shaft at rest and the spacebar interposer released, adjust the interposer guide left or right to obtain .015"-.025" clearance between the interposer and the lockout cam lug.



The purpose of the backspace mechanism is to move the carrier to the left one space at a time. The backspace mechanism also has a "typamatic" feature that causes a repeat operation when the keybutton is held fully depressed.

Since operational control was covered with the spacebar mechanism, this section will be concerned only with the backspace mechanism after the latch begins to operate.

The backspace latch assembly is mounted on a pivot stud permanently affixed to the backplate in the right rear of the machine. The latch assembly receives its motion from the cam follower lever. This motion is transferred by the intermediate backspace lever to the backspace rack.(Fig. 1)

The backspace rack is mounted on shouldered studs to the power frame. As the backspace rack moves to the left, the backspace pawl is engaged.

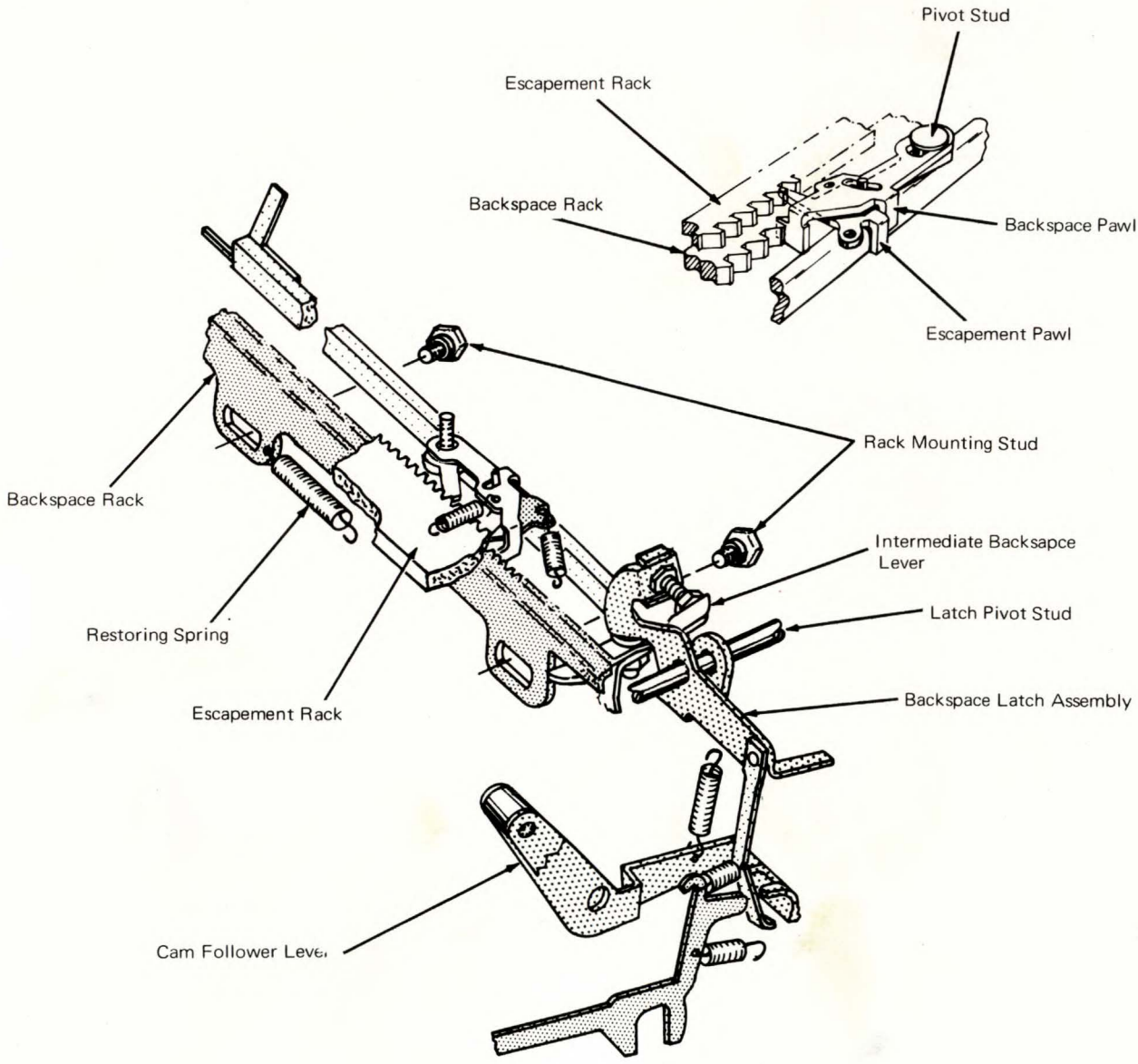


Figure 1 – Backspace Mechanism

The backspace pawl is mounted directly above the escapement pawl to the escapement bracket. Movement of the backspace pawl to the left also moves the carrier and the escapement pawl to the left. (Fig. 2)

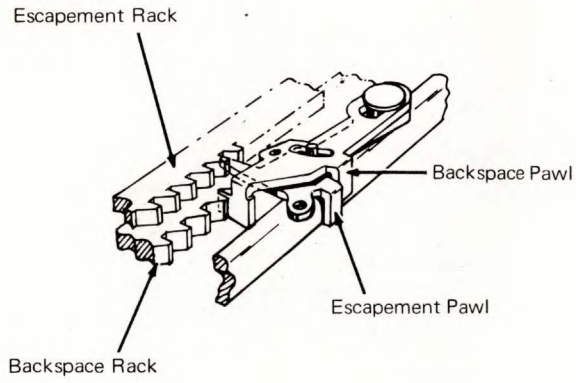


Figure 2 – Escapement Pawl and Backspace Pawl Mounting

The escapement pawl and backspace pawl move front to rear independently. The escapement pawl has a small upright stud on its upper surface which extends through an elongated slot in the backspace pawl. This allows the escapement pawl to cam to the rear and fall into the previous tooth of the escapement rack as the backspace rack moves the carrier to the left. (Fig. 3)

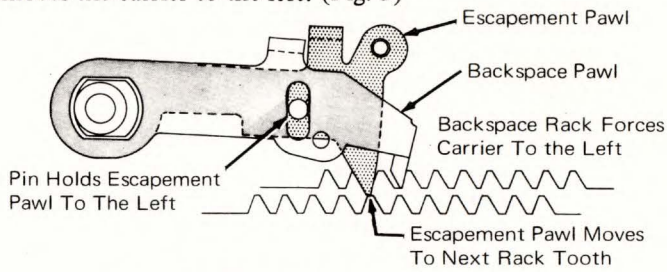


Figure 3 – Backspace Actuating Stroke

The backspace rack is spring loaded to the right. As a backspace operation is completed, the backspace rack returns to its rest position. The carrier is held by the escapement pawl and the backspace pawl drops into the next tooth of the backspace rack as the rack restores. (Fig. 4)

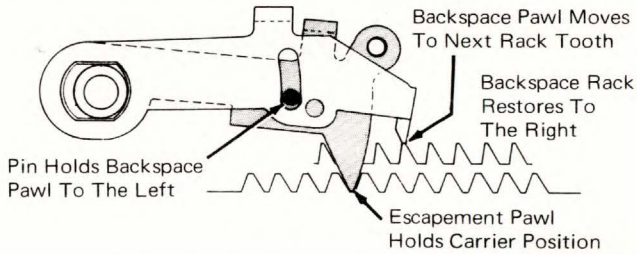
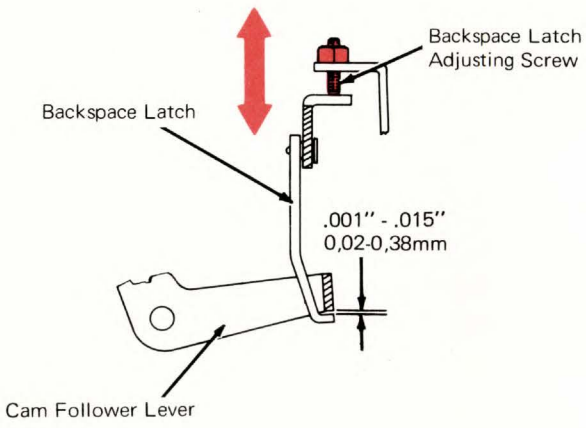


Figure 4 – Backspace Restoring Stroke

BACKSPACE ADJUSTMENTS

NOTE: All operational control adjustments must be correct before attempting to make backspace adjustments.

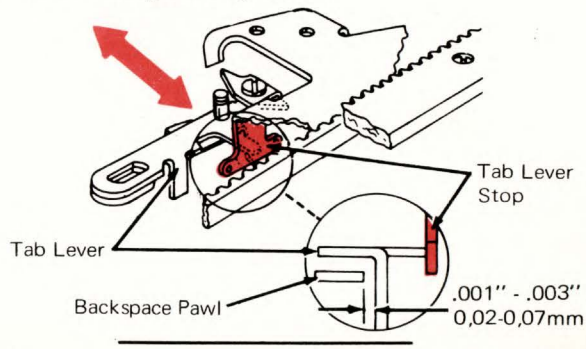
1. *Backspace Latch Height* – Adjust the backspace latch adjusting screw for .001" - .015" clearance between the latch and the cam follower lever. This adjustment should be made to the low side of the spec to ensure a minimum of lost motion.



2. *Tab Lever Stop* – Form the stop front-to-rear for a clearance of .001" - .003" between the vertical lug on the tab lever and the backspace pawl when the pawl is bottomed in its rack.

   NOTE: Make sure the escapement bracket and all print escapement adjustments are correct before forming the stop.

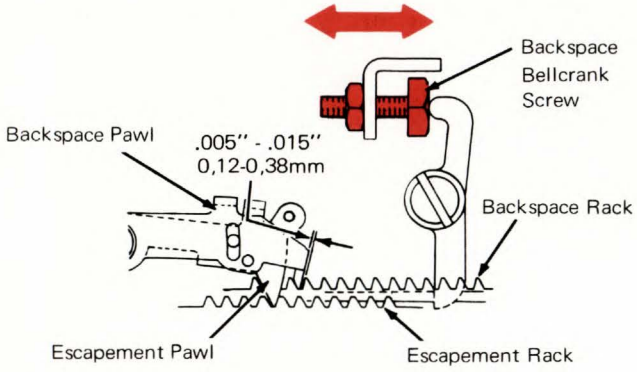
   This adjustment ensures that the backspace pawl will not be prevented from bottoming in its rack during a backspace operation. It also determines the motion necessary for the tab lever to remove the escapement and backspace pawls from their racks during a tab operation.



3. *Backspace Rack* – With the machine at rest, adjust the backspace bellcrank screw in or out to obtain .005" - .015" clearance between the working surface of a rack tooth and the backspace pawl. Check at both ends of the writing line.

This adjustment minimizes lost motion and ensures that the backspace pawl will positively reset in the next rack tooth at the completion of a backspace operation.

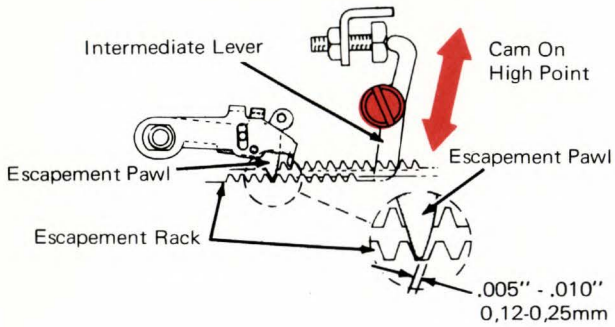
Excessive clearance can cause escapement problems as well as backspace problems by allowing the backspace pawl, instead of the escapement pawl, to hold the carrier.



4. *Backspace Motion* – This adjustment is obtained by adjusting the intermediate lever front-to-rear. Any time this adjustment is changed, the backspace rack adjustment (3) should be checked and readjusted if necessary. Moving the lever to the rear increases backspace rack motion.

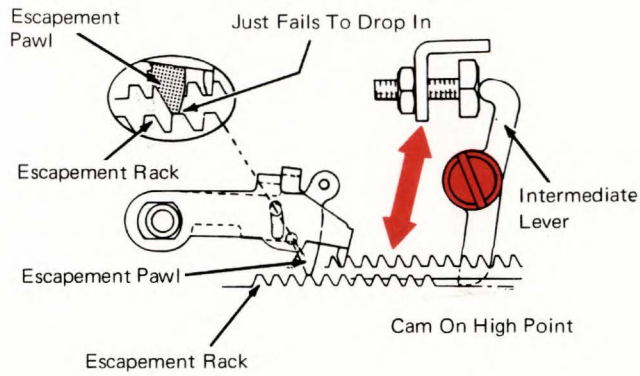
Level 1 (Below S/N 4012015) – With the backspace cam manually operated to the high point, the escapement pawl should drop into the preceding rack tooth and overthrow by .005" - .010". Adjust the intermediate lever front-to-rear to obtain this adjustment.

Level 1

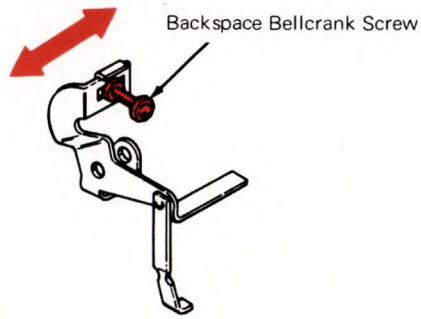


Level 2 and 3 – Adjust the intermediate lever on level 2 and the backspace bellcrank adjusting screw on level 3 so that a backspace operation just fails under hand operation. During a powered backspace operation, the carrier develops enough momentum for a positive operation. Too much motion will cause double or space-and-a-half backspacing.

Level 2



Level 3



The tab mechanism provides the operator with rapid carrier movement to the right to a pre-determined position on the writing line. The tab mechanism may be used for "tabulating" columns of figures, indenting paragraphs or any other application that requires positioning the carrier to a specific point.

To accomplish this, several things take place in a very short period of time. To better understand a tab operation, the information will be presented in time sequence.

Tab Set And Clear

The tab rack, located parallel to and just to the rear of the escapement rack, allows the operator to select the positions where the carrier will stop during a tab operation. The tab stops operate in slots in the rack with one stop for each escapement position. The tab set and clear button may be rocked forward or backward to set or clear a tab stop. (Fig. 1)

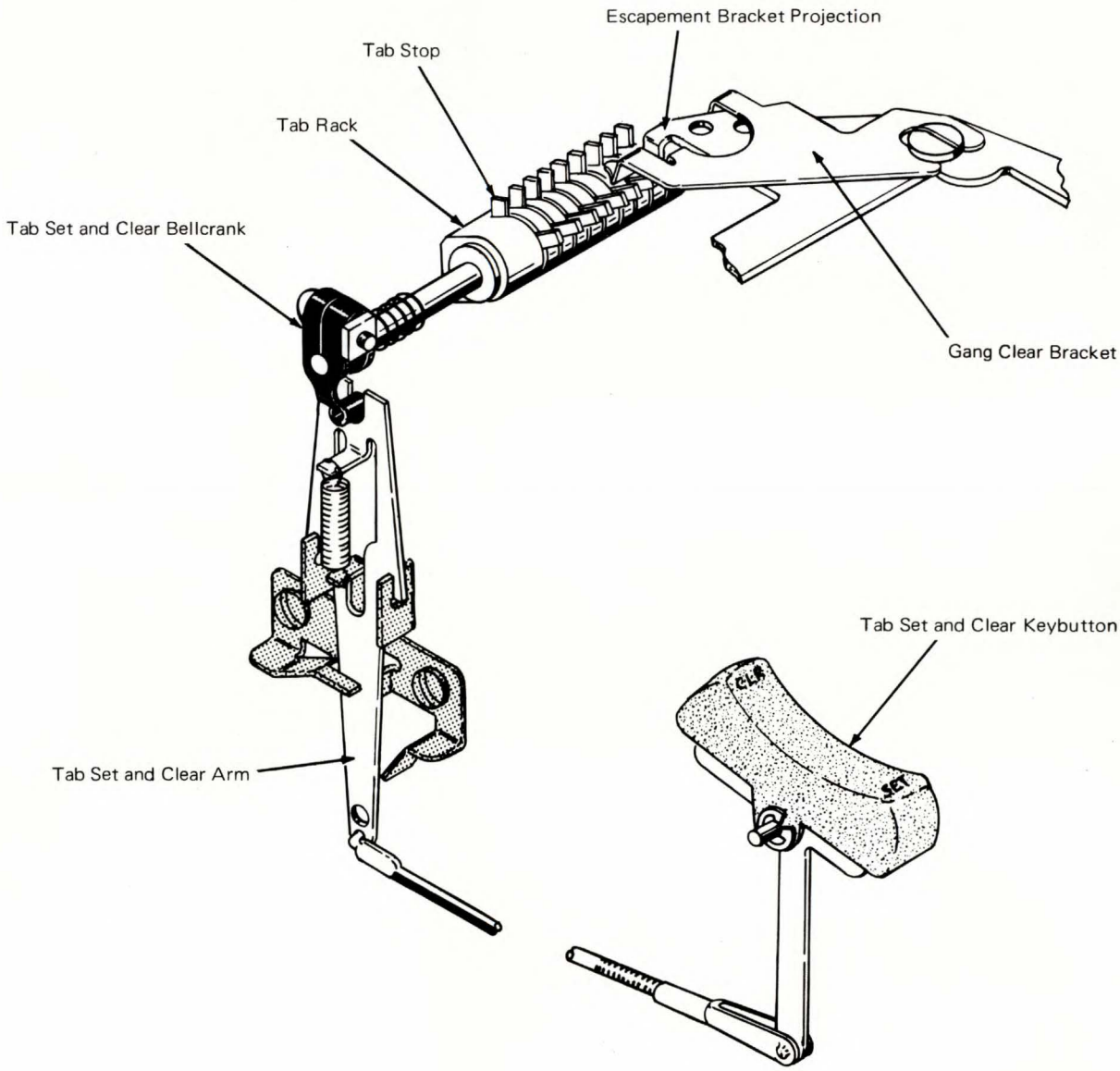
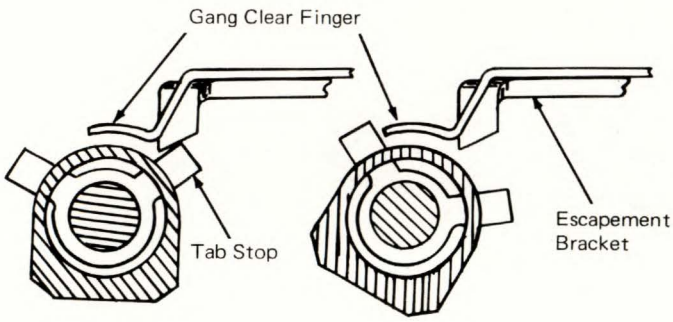


Figure 1 – Tab Set And Clear Mechanism

When the front, or set position of the keybutton, is depressed, an extension on the bottom of the keybutton pushes, through a connecting link, the tab set and clear arm. The tab set and clear arm pivots the tab set and clear bellcrank, which rotates the tab rack. As the tab rack rotates, a tab stop corresponding to the carrier position contacts a projection on the escapement bracket. As the tab rack continues to rotate, the tab stop is forced to turn within the tab rack. When the tab set button is released, the tab rack restores to its rest position. The working surface of the tab stop will be lower than the other tab stops, or in the "set" position. The tab stop is then in a position to stop the latched out tab lever during a tab operation. (Fig. 2)

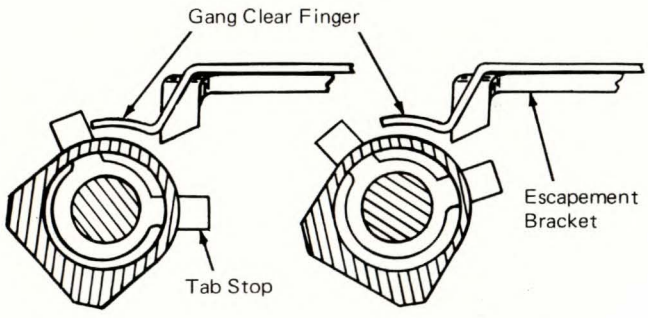


A. Set Operation *B. Set Position*

Figure 2 – Tab Set Operation

A set tab stop may be cleared by depressing the rear of the tab set and clear button. This rotates the tab rack in the opposite direction. The set tab stop contacts the gang clear finger. (Fig. 3)

As the rack continues to rotate, the tab stop turns within the tab rack to its "cleared" position. As the keybutton is released, the rack restores to its rest position and the previously set tab stop is in line with the other tab stops.



C. Clear Operation *D. Clear Position*

Figure 3 – Clear Operation

If the carrier is at the right margin and the carrier return mechanism is operated while the tab clear button is held depressed, all set tab stops will be cleared as the carrier moves to the left. This is accomplished by the gang clear bracket which is mounted to the escapement bracket.

Tab Actuating

The tab mechanism is activated by depressing the tab keybutton located at the upper left corner of the keyboard. As the keylever pivots on its fulcrum rod, the lower extension of the keylever moves to the rear. This extension is connected to the tab bellcrank by the tab keylever link. The tab bellcrank is connected to an arm on the tab torque bar by the tab torque bar link. The tab torque bar is mounted parallel to the print shaft at the rear of the carrier. Depressing the keylever will cause the bottom of the tab torque bar to pivot to the rear. The torque bar will remain pivoted to the rear until the keylever is released. (Fig. 4)

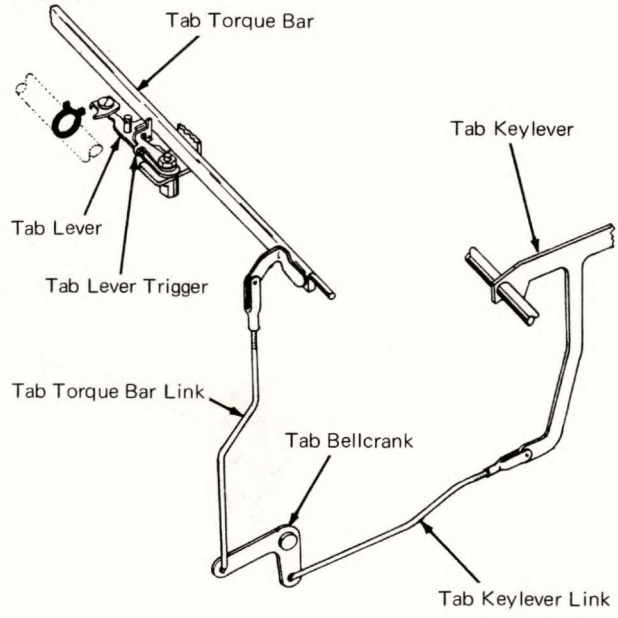


Figure 4 – Tab Latch Operation

Pawl Removal

As previously mentioned, the purpose of the tab mechanism is to quickly move the carrier to the right to a predetermined point. Therefore, it is necessary to remove the escapement and backspace pawls from their respective racks and restore them at the proper time and place.

Pawl removal is initiated by the tab torque bar pushing against the tab lever trigger. The lower lug of the tab lever trigger pushes the tab lever to the rear. (Fig. 5)

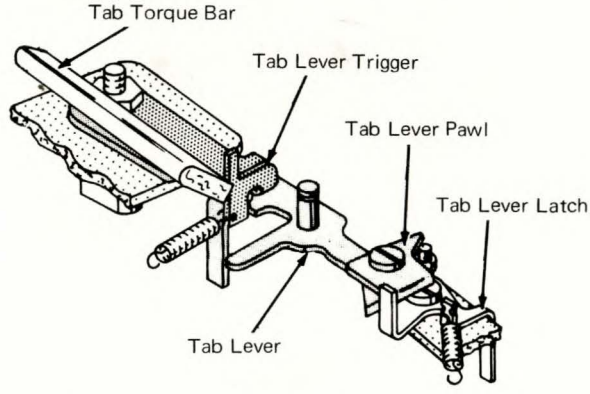


Figure 5 – Pawl Release Operation

As the tab lever is moved to the rear, its lower lug contacts the backspace and escapement pawls and moves them to the rear out of their racks. When the escapement pawl just clears its rack, it is pulled to the right by the pawl spring. The backspace pawl will move to the right an equal amount because of the upright stud connection between the escapement pawl and backspace pawl. (Fig. 6)

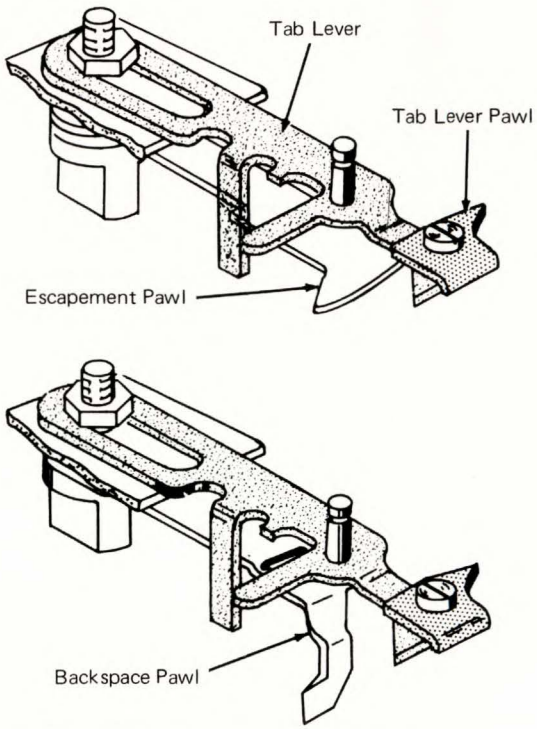


Figure 6 – Tab Lever Mechanism

As the pawls move to the right, they are also moved further to the rear by the tab lever. The tab lever will continue to be moved by the trigger until the trigger is restricted by the tab overthrow stop. When the keybutton is released, the tab lever will be held to the rear by the tab lever latch. (Fig. 7)

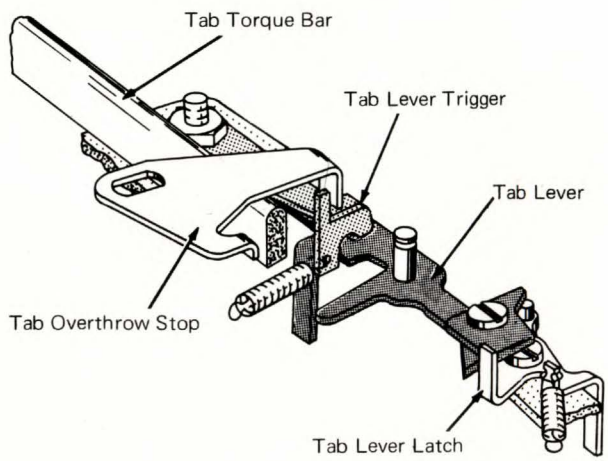


Figure 7 – Tab Overthrow Stop

Tab Governor

As soon as the escapement and backspace pawls have left their racks, the carrier begins to move to the right. This is accomplished by mainspring tension which was discussed under the escapement mechanism. The carrier speed during a tab operation, especially a tab over eight spaces, must be restricted or the constant pull of the mainspring will accelerate the carrier beyond a safe speed, causing parts breakage and/or stopping at the wrong position. The tab governor controls the carrier speed by limiting the speed in which the escapement cord drum can wind up the tab cord. (Fig. 8)

The escapement cord drum is connected to the operational shaft by a beveled gear which meshes with the tab governor pinion gear. The tab governor pinion gear rides on the operational shaft between two collars that are setscrewed to the operational shaft. The left collar and the pinion gear have hubs that are connected by a spring clutch. The spring clutch is wound so that it slips when the operational shaft is turning and the escapement cord drum is holding the pinion gear stationary.

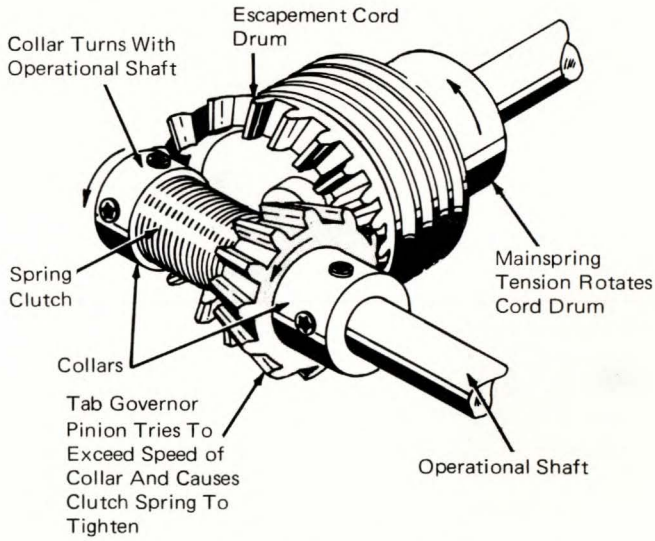

Escapement Cord Drum
Collar Turns With Operational Shaft
Spring Clutch
Mainspring Tension Rotates Cord Drum
Collars
Tab Governor Pinion Tries To Exceed Speed of Collar And Causes Clutch Spring To Tighten
Operational Shaft

Figure 8 – Tab Governor Mechanism

During a tab operation, the escapement cord drum drives the pinion gear in the same direction as the operational shaft. As soon as the rotational speed of the pinion gear exceeds that of the operational shaft, the friction present in the spring clutch causes it to tighten around the two hubs locking the pinion gear and the collar together. Since the collar is setscrewed to the operational shaft, the escapement cord drum speed will be limited by the speed of the operational shaft. Therefore, carrier speed during a tab operation is governed by the gear ratio between the pinion gear and the escapement cord drum.

The tab pinion gear and the carrier return pinion gear are the same size. Since both pinion gears mesh with the escapement cord drum, the velocity of the carrier return and the tab operation are the same after the governor has taken affect.

Tab Unlatching

As the carrier moves to the right, the tab lever contacts a set tab stop. The tab lever stops moving. However, the carrier and pawls will continue moving to the right because of the elongated mounting hole in the tab lever. Continued movement of the carrier and pawls past the stopped tab lever will cause the escapement pawl to slide off the lug on the tab lever. The escapement pawl will then be free to restore back into the rack under its spring load. The backspace pawl does not have a cut out notch so it will remain held by the tab lever lug. (Fig. 9)

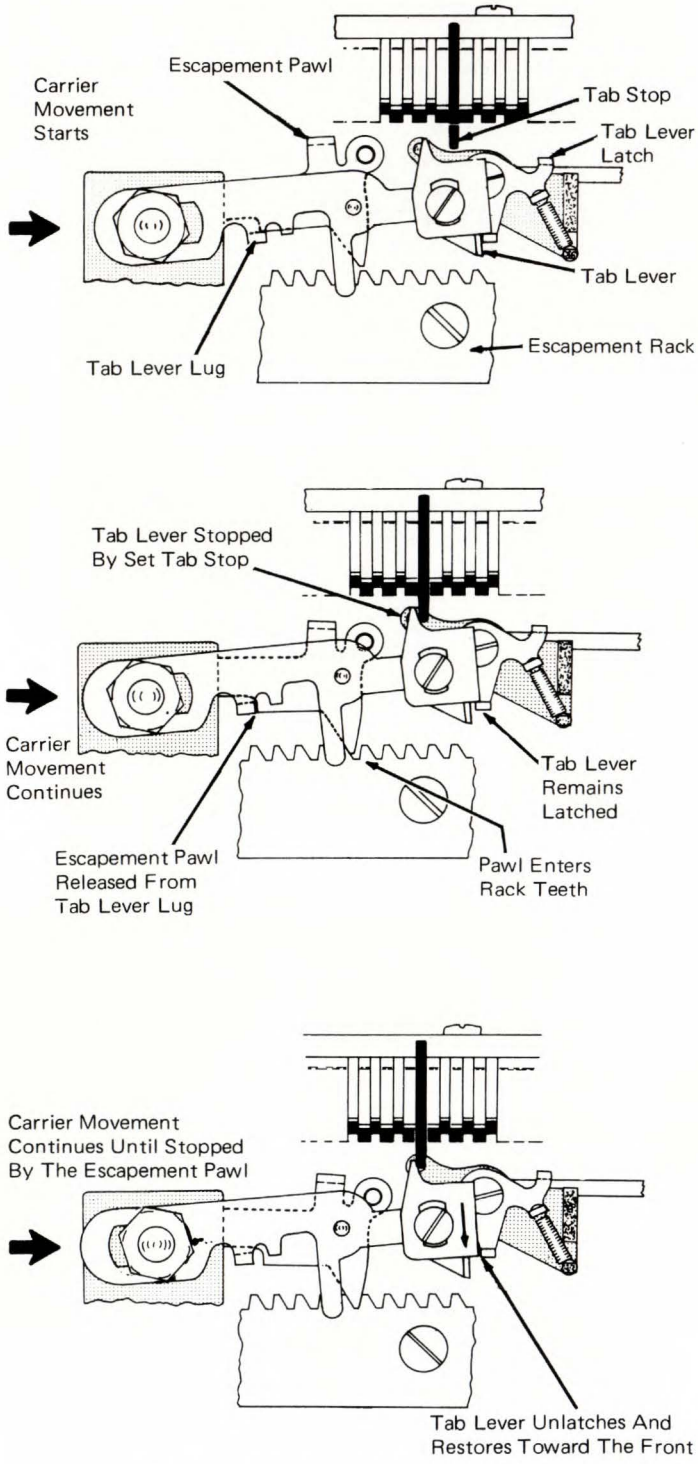

Escapement Pawl
Carrier Movement Starts
Tab Stop
Tab Lever Latch
Tab Lever
Escapement Rack
Tab Lever Lug
Tab Lever Stopped By Set Tab Stop
Carrier Movement Continues
Tab Lever Remains Latched
Escapement Pawl Released From Tab Lever Lug
Pawl Enters Rack Teeth
Carrier Movement Continues Until Stopped By The Escapement Pawl
Tab Lever Unlatches And Restores Toward The Front

Figure 9 – Tab Unlatching Operation

Further movement of the carrier in relation to the stopped tab lever will cause the tab lever latch to release the tab lever. When the tab lever restores, it will allow the backspace pawl to re-enter its rack.

Although all parts have been unlatched and restored to their respective racks or rest positions, the carrier has not stopped. When the escapement pawl was unlatched on the tab lever lug, its spring tension held the escapement pawl fully extended to the right in its elongated mounting hole and against the left side of the pawl mounting stud. After the escapement pawl enters the rack, its movement to the right is stopped by a rack tooth. However, the carrier continues to move to the right until the pawl mounting stud contacts the right side of the elongated slot in the escapement pawl and stops.

Tab Trigger

The function of the tab trigger is to allow the tab lever to restore at the end of a tab operation if THE TAB KEYBUTTON IS STILL HELD DEPRESSED BY THE OPERATOR. The tab lever and tab trigger are designed so that when the tab lever is moved to the left after contacting a set tab stop it will slide off the trigger lug which was holding it to the rear. With the trigger no longer holding the tab lever out, it is free to restore in the normal manner. When the tab keybutton is released, the tab trigger will restore to its rest position. At this time, the tab lever will be snapped to the right by its spring, resetting the tab lever behind the tab trigger lug. In addition, the tab lever moving to the right will also reset its lug in front of the escapement pawl in a position to move it out of the rack on the next tab operation. (Fig. 10)

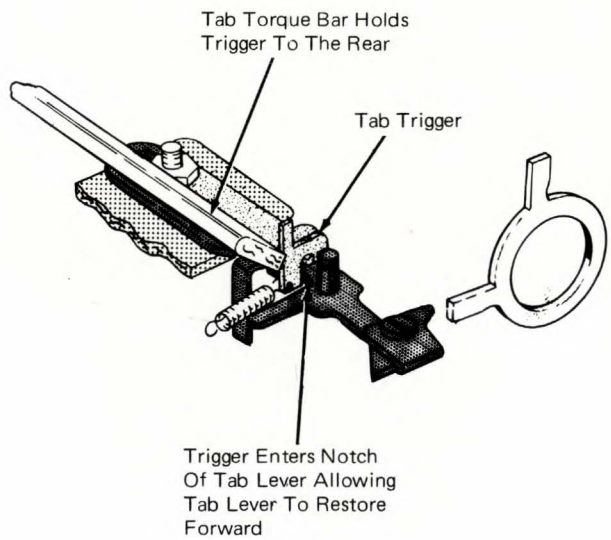

Tab Torque Bar Holds Trigger To The Rear
Tab Trigger
Trigger Enters Notch Of Tab Lever Allowing Tab Lever To Restore Forward

Figure 10 – Tab Lever Trigger Operation

Tab Interlock

The tab interlock prevents the tab lever from being latched to the rear during a carrier return operation. If the tab lever were allowed to latch, the tab lever pawl could strike the right side of a set tab stop during a carrier return operation and lock the carrier. To prevent this from happening, the tab lever latch has a lower lug extending behind the escapement torque bar. When the escapement torque bar is pivoted, the tab lever latch will be rotated out of its latching position, thus preventing the tab lever from being latched out. The escapement torque bar pivots during a carrier return operation, spacebar operation, or print escapement operation. (Fig. 11)

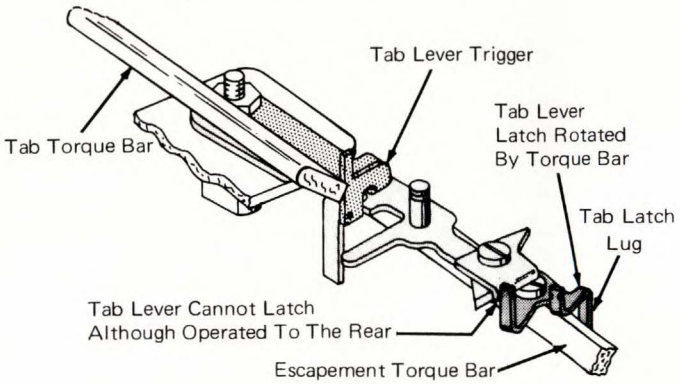


Figure 11 – Tab Interlock

Carrier Return/Tab Interlock

The carrier return tab interlock allows a tab operation to supersede or unlatch a carrier return operation once the carrier return operation has begun. Pressing the tab keybutton during a carrier return operation will pivot the tab torque bar to the rear so that a lug on its right end will pivot the carrier return/tab interlock extension of the carrier return latch keeper. When the carrier return/ tab interlock lever is pivoted by the torque bar, the extension will unlatch the carrier return. (Fig. 12)

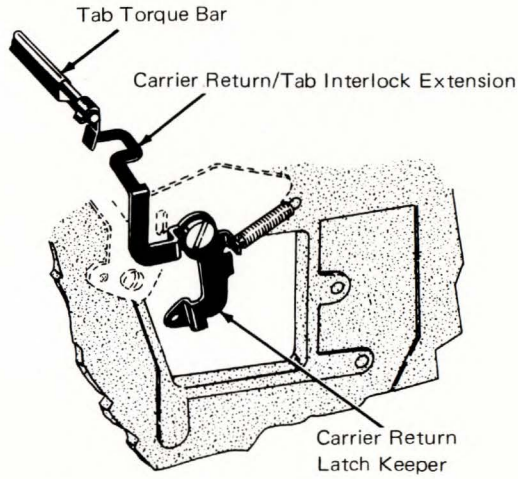
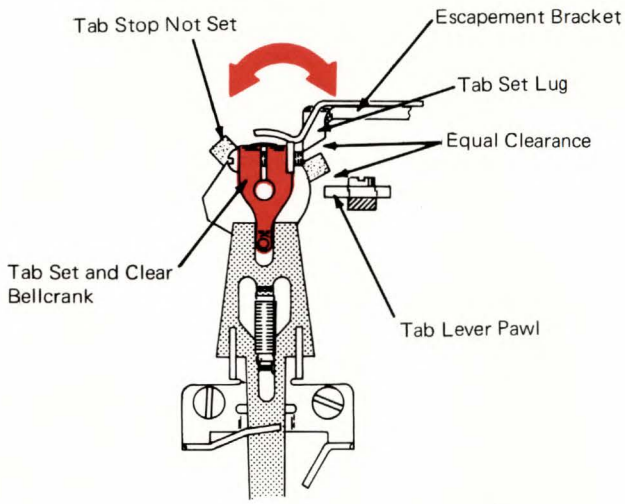


Figure 12 – Carrier Return/Tab Interlock

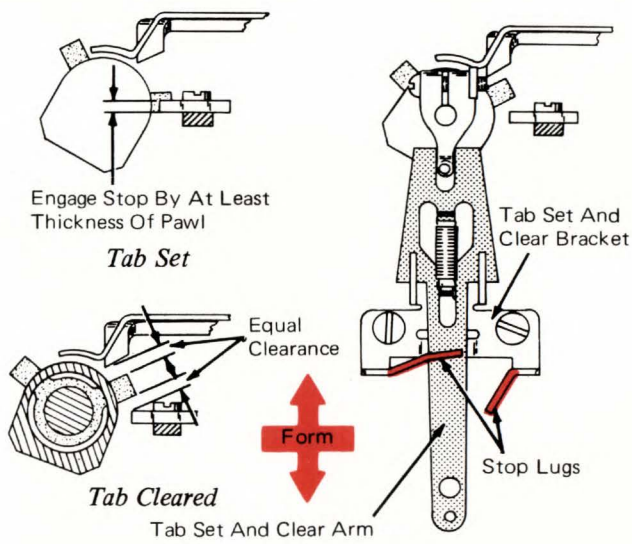
TABULATION ADJUSTMENTS

1. *Tab Rack – Radially*, – With the tab lever latched to the rear, the unset tab stops should be centered between the tab lever pawl and the tab set lug on the escapement bracket. Loosen the screw on the tab set and clear bellcrank and rotate the tab rack to make this adjustment.



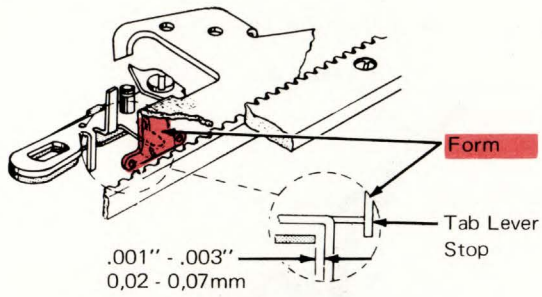
2. *Tab Set and Clear Bracket* – Form the stop lugs on the set and clear bracket so that the movement of the set and clear arm is restricted as the tab stops fully reach their set or clear position.

NOTE: On the early style tab set and clear mechanism, the stop lugs were anchored and adjusted by two screws on the outside of the power frame.

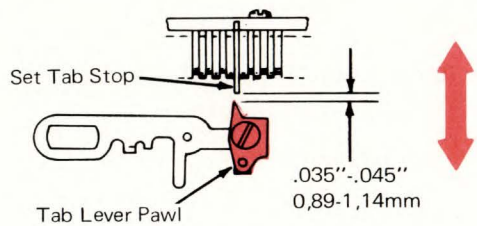


3. *Tab Lever Stop* – Form the stop front to rear for a clearance of .001" - .003" between the vertical lug on the tab lever and the backspace pawl when the pawl is bottomed in its rack.

NOTE: Make sure all escapement bracket and print escapement adjustments are correct before forming this stop.

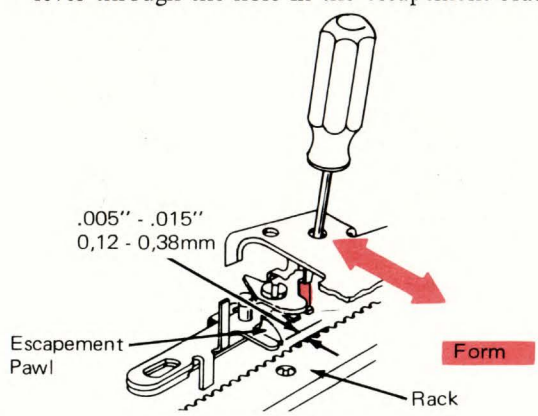


4. *Tab Lever Pawl* – Adjust the tab lever pawl front to rear for .035" - .045" clearance between the tip of the tab lever pawl at rest and the set tab stops. The adjustment of the tab lever pawl has an effect on the amount of overlap between the tab stop and the pawl tip in the active position. It also affects pawl clearance during tabulation. Unless the tab lever pawl is properly adjusted, correct pawl clearance can not be obtained.

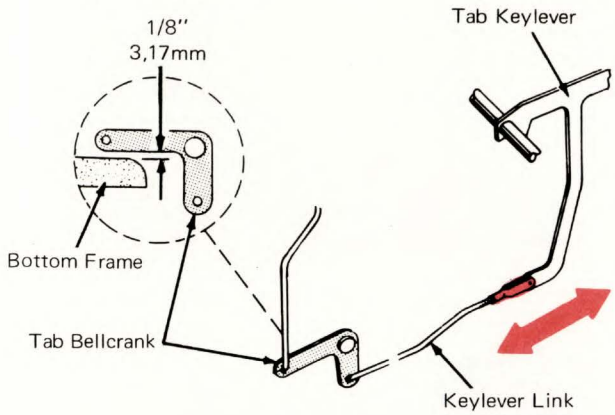


5. *Pawl Clearance* – Form the upright lug on the tab latch for a clearance of .005" - .015" between the tip of the escapement pawl and escapement rack teeth with the tab lever latched to the rear. This adjustment ensures that the escapement pawl will re-enter the rack as quickly as possible to minimize the chances of entering the wrong tooth.

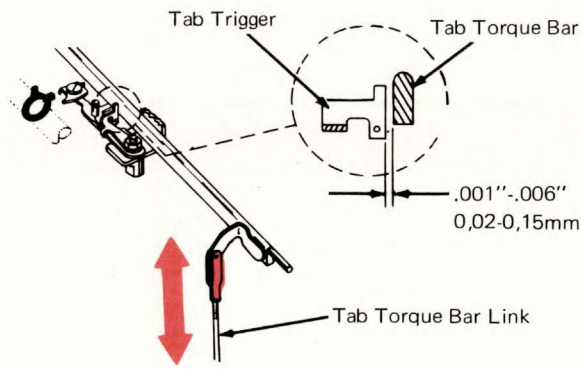
The upright lug of the tab latch may be formed with the three inch screwdriver by using it as a lever through the hole in the escapement bracket.



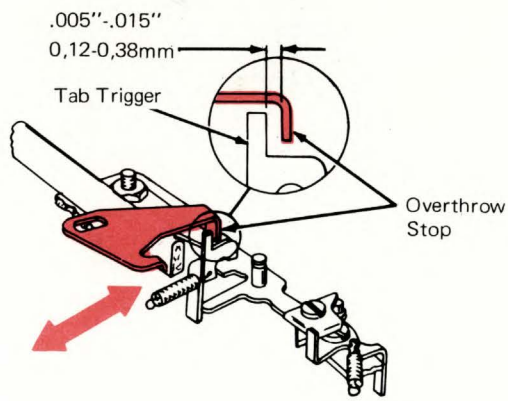
6. *Keylever Link* – Adjust the link on the tab keylever extension so that the rear arm of the tab bellcrank rest approximately 1/8" above the bottom frame.



7. *Tab Torque Bar Link* – Adjust the tab torque bar link for a clearance of .001"-.006" between the tab torque bar and the tab lever trigger at rest.

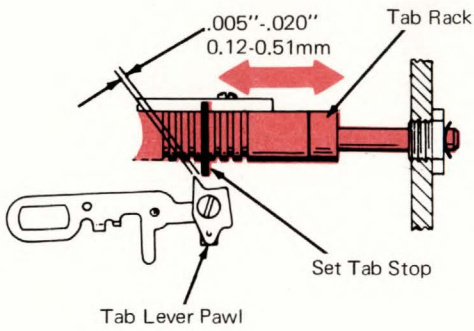


8. *Overthrow Stop* – Adjust the stop front to rear for .005" - .015" clearance between the lug on the overthrow stop and the upright lug on the tab lever trigger with the tab lever latched to the rear.



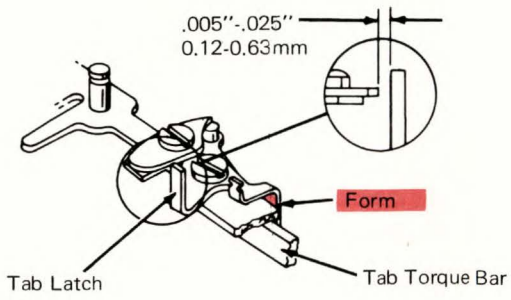
9. *Tab Rack Left to Right* – Adjust the tab rack left to right for .005" - .020" clearance between the tip of the tab lever pawl and the left side of a set tab stop.

To make this adjustment, clear all the tab stops. Set one tab stop, backspace once and then turn the machine off. The tip of the tab lever pawl should be just to the left of the tab stop. Hold the carrier to prevent it from moving and observe the tab lever pawl as you slowly depress the tab key-button. The tip of the tab lever pawl should clear the left side of the tab stop by .005" - .020".



10. *Tab Interlock* – With the carrier return clutch latched, the escapement torque bar should rotate the tab latch away from the tab lever pawl by .005" - .025".

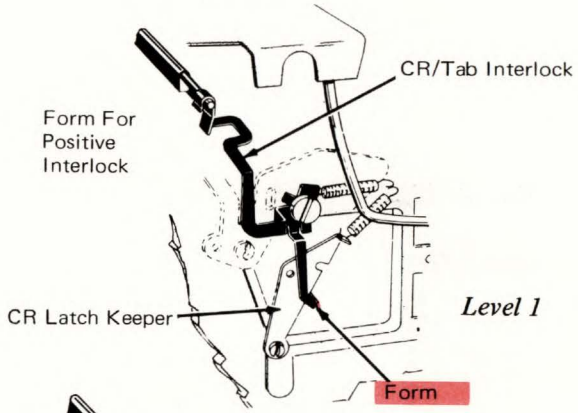
This adjustment is obtained by forming the lug on the tab latch that extends down behind the escapement torque bar. The adjustment ensures that the carrier return and tab cannot both be latched out simultaneously. If both were allowed to latch, the tab lever pawl would lock against a set tab stop during the carrier return operation.

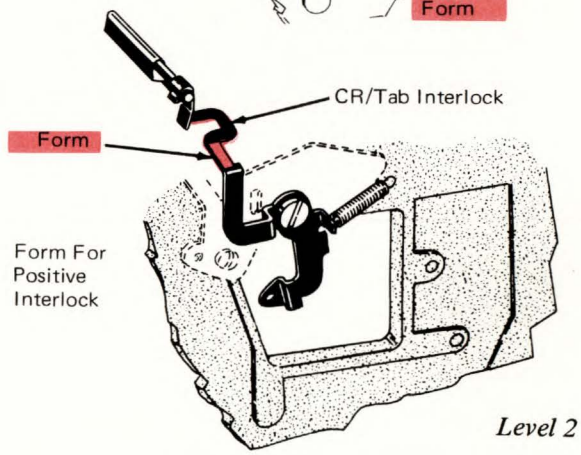


11. *Carrier Return/Tab Interlock* – Form the lug of the interlock to obtain the following conditions:

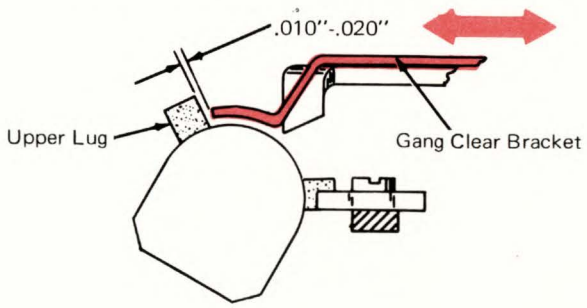
a. With the carrier return mechanism latched, the interlock should pull the carrier return latch keeper forward just enough to release the latch when the tab lever is fully depressed.

b. With the carrier return mechanism at rest, full depression of the tab keylever should not cause the carrier return keeper to move away from the latch.

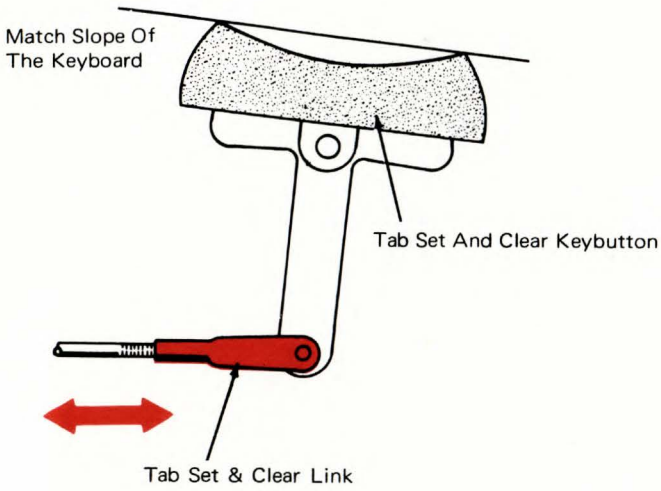




12. *Gang Clear Bracket* – Adjust the gang clear bracket front to rear for .010" - .020" between it and the upper lug on a set tab stop. If necessary, form the tip of the gang clear bracket to ensure that it does not contact the tab rack at any place along the writing line. Clearance between the tab rack and the tip of the gang clear bracket should be kept to a minimum.



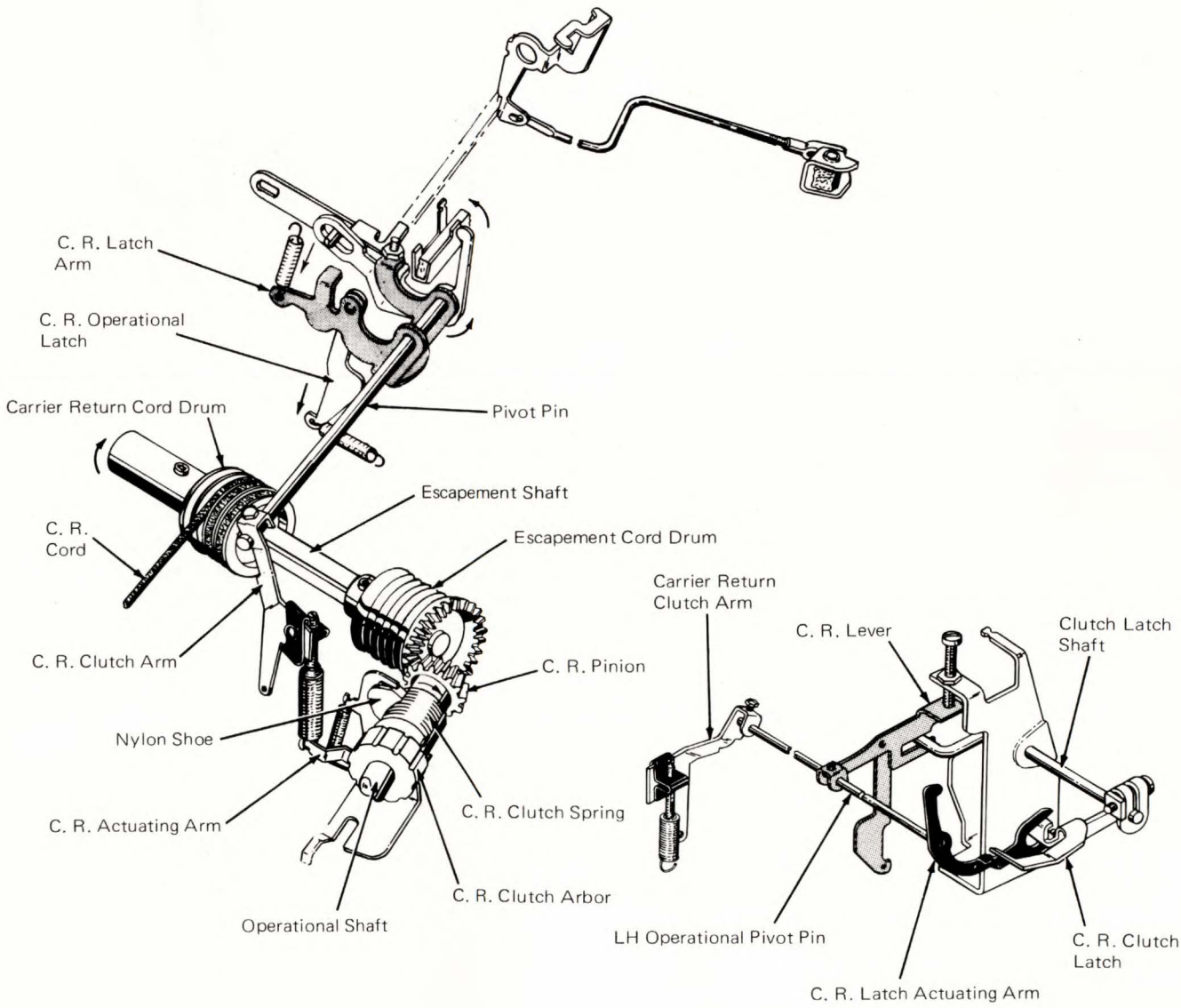
13. *Tab Set And Clear Link* – Adjust the tab set and clear link so the tab set and clear keybutton matches the slope of the keyboard.



CARRIER RETURN OPERATIONAL THEORY

The carrier return mechanism returns the carrier to the left hand margin and automatically line spaces the paper whenever the carrier return keylever is depressed. Further depression of the carrier return keylever causes additional index operations.

The carrier is moved to the left hand margin by winding the carrier return cord onto a drum mounted on the rear of the escapement shaft in front of the mainspring. As the escapement shaft rotates, the carrier return cord drum will wind up the cord and move the carrier to the left. The carrier return cord passes to the left over a roller guide and around two pulleys on the left hand side of the machine. It is then hooked to the bottom of the carrier. (Fig. 1)



7X1 Left Front View *7X3–7X5 Right Front View*

Figure 1–Carrier Return Mechanism

The power to turn the escapement shaft is taken directly from the operational shaft. The escapement cord drum has a beveled gear molded on its front which meshes with a carrier return pinion gear that turns freely on the operational shaft. A spring clutch is employed to cause the carrier return pinion gear to rotate with the operational shaft. The pinion gear drives the escapement cord drum in a clockwise direction causing the carrier return cord to be wound onto its drum. (Fig. 2)

The left hand end of the carrier return pinion forms the arbor for the carrier return spring clutch. A second hub, the carrier return clutch arbor, is just to the left of the carrier return pinion. This hub is in constant rotation with the operational shaft and the carrier return clutch spring is anchored to this hub by a spring clip. The operational shaft turns in the tightening direction of the spring, however, no drive occurs because the pinion hub is smaller than the inside diameter of the spring clutch. When the loose end of the carrier return clutch spring is pressed against the pinion hub, the spring clutch will tighten around the hub and drive the pinion. The tension of the spring clutch resists any change in size and will snap back to its normal size when the external pressure is released.

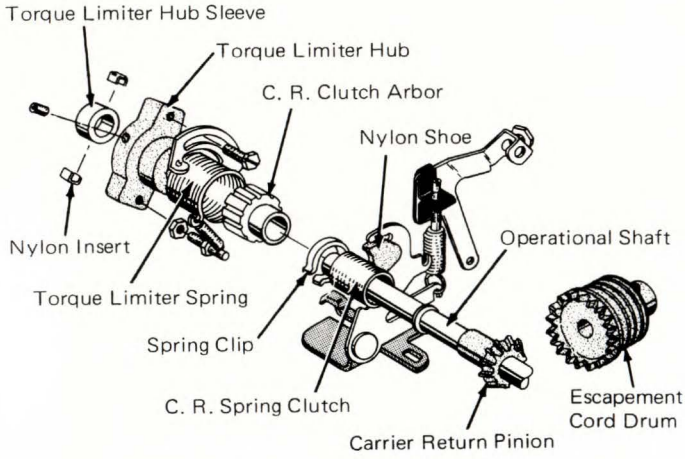


Figure 2–Carrier Return Clutch

The external pressure required to cause the carrier return spring clutch to drive is applied by a nylon shoe. The power to operate the nylon shoe against the clutch spring is taken from a single lobed operational cam. (Fig. 3)

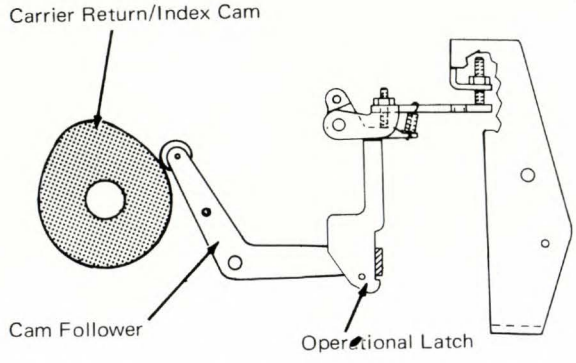


Figure 3 – Carrier Return Latch

First, let's discuss the 7X3, 7X5 mechanism. When the carrier return operational latch is pulled down by the cam follower, the latch pulls the carrier return lever down. As the carrier return lever moves down, it pivots the clutch latch shaft. Attached to the right hand end of the clutch latch shaft is the carrier return clutch latch. As the carrier return clutch latch moves downward, it rotates the latch actuating arm which will pivot the escapement torque bar and remove the escapement pawl from the escapement rack. The clutch latch and latch actuating arm are latched in their operated position. (Fig. 4)

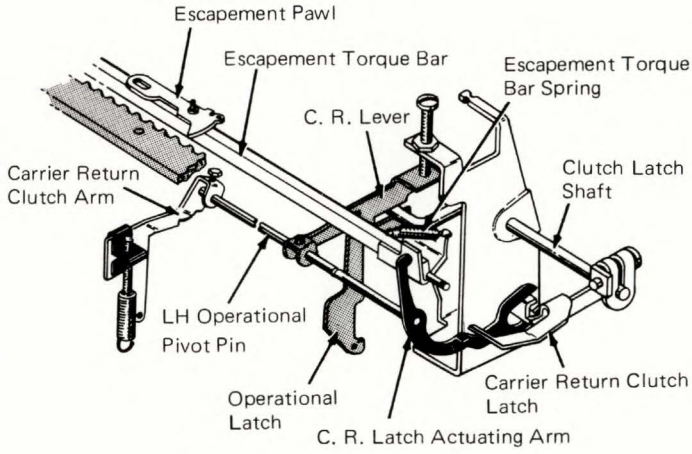


Figure 4–Carrier Return 7X3–7X5

The left hand operational pivot pin is set screwed to the carrier return lever and pivots about its mounting hole as the carrier return lever moves downward. Located on the left end of the left hand operational pivot pin is the carrier return clutch arm. As the carrier return clutch arm moves upward, the carrier return shoe actuating arm pivots and forces the carrier return shoe into the spring clutch. The carrier return clutch latch causes the carrier return mechanism to be latched in this active position until the carrier reaches the left hand margin. At that time, the clutch is unlatched and the escapement pawl is allowed to restore into the rack. (Fig. 5)

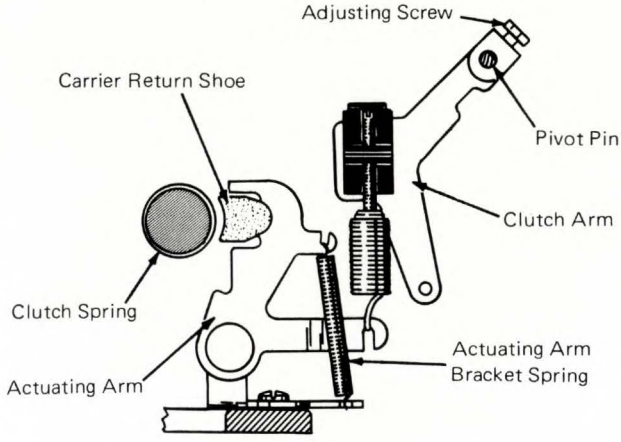
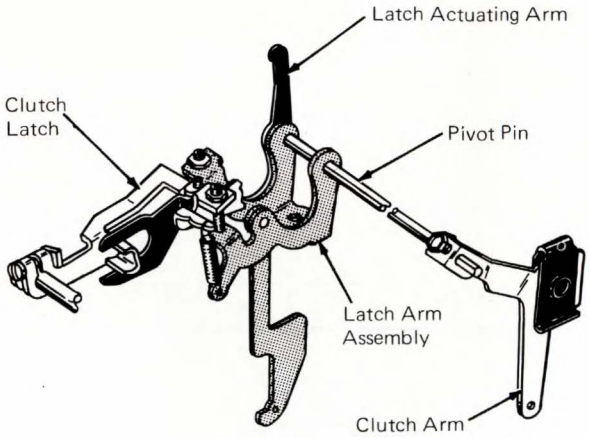


Figure 5– Carrier Return Shoe

The carrier return mechanism on 7X1 machines is basically the same as the mechanism just described. The two main differences between the mechanisms are that the carrier return clutch arm is mounted directly to the latch actuating arm pivot pin and that the latch arm assembly is not set screwed, but is allowed to pivot on the pivot pin. (Fig. 6)



7X1 Rear View

Figure 6 – Carrier Return Mechanism

When the carrier reaches the left hand margin, the carrier return mechanism must be restored to rest. The clutch is unlatched and the escapement pawl is restored to the escapement rack, ready for an escapement operation. The margin rack is mounted between the side frames and in front of the carrier. The margin rack has a small amount of lateral movement. When the carrier is away from the left hand margin, a spring, located at the left end of the margin rack, loads the margin rack to the right. The carrier strikes the left hand margin stop and forces the margin rack to the left. An extension on the overbank guide located on the right hand end of the margin rack will pivot the carrier return unlatching bellcrank. Operating the bellcrank, pulls the connecting link between the carrier return unlatching bellcrank and the carrier return latch keeper, pulling the keeper forward and releasing the clutch latch. The latch is restored to the rest position by the actuating arm bracket spring and the escapement torque bar spring. (Fig. 7)

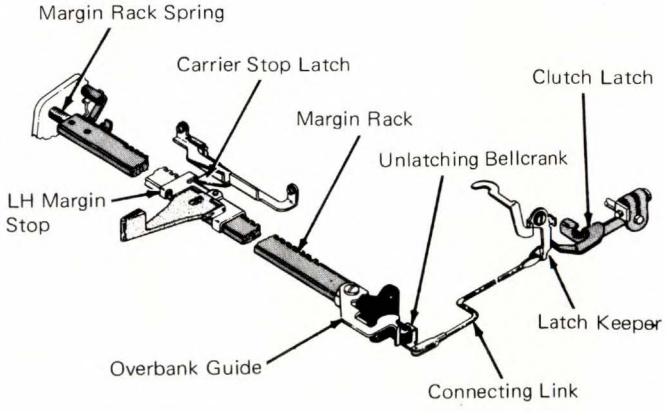


Figure 7– Clutch Unlatching

If the carrier is already resting at the left hand margin when a carrier return operation is initiated, the clutch is prevented from latching. The cam is not prevented from operating so a carrier return operation must occur. The carrier cannot be pulled farther to the left, because it is already against the left margin. The pull continues on the carrier return cord until the cam follower passes the high point of the cam. During the time the cord is being pulled without moving the carrier, the carrier return mechanism must be allowed to slip in order to reduce the strain and prevent parts breakage. (Fig. 8)

The carrier return clutch arbor is indirectly driven by the operational shaft. A large shoulder on the arbor fits into a heavy clutch spring at the left called the torque limiter spring. The left hand end of the torque limiter spring is anchored, by an adjustable clamp, to the torque limiter hub. The torque limiter hub is set screwed to the operational shaft.

The operational shaft turns in the unwinding direction of the torque limiter spring. This tends to expand it and allow it to slip. The spring, however, is heavy and considerably smaller in diameter than the carrier return clutch arbor, over which it fits. The friction present between the arbor and the spring, tends to drive the arbor even though it is in the unwinding direction of the spring, but insufficient driving force is obtained from this arrangement. The right end of the torque limiter spring has a loop formed to accept an extension spring. The extension spring is connected between this loop and an eccentric stud on the torque limiter hub. The extension spring increases the force required to unwind the torque limiter spring so that no slippage occurs during normal carrier return. The torque limiter spring slips when the carrier cannot move to the left. It also slips at the beginning of a carrier return operation to allow smooth acceleration and prevent a jerky start.

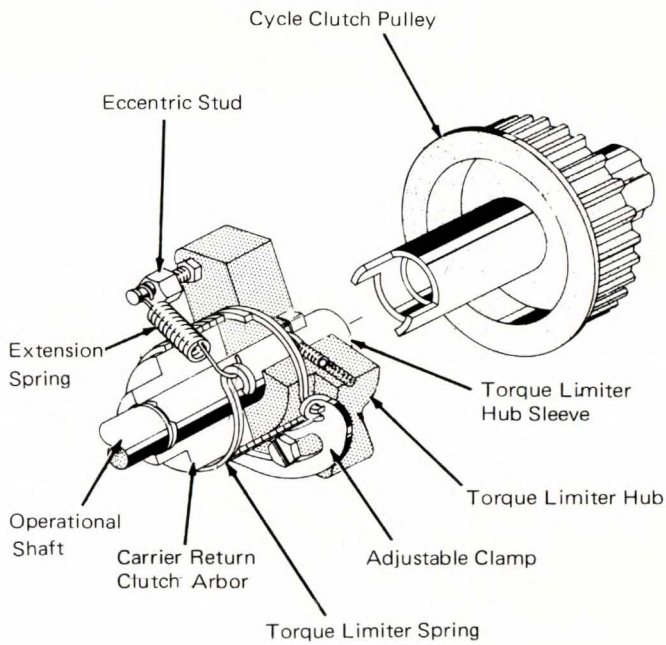


Figure 8–Torque Limiter–Cut Away View

To prevent the operator from beating the carrier return, an interlock is used to prevent the cycle clutch from releasing anytime the carrier return mechanism is operated. A link is connected between the carrier return actuating arm and the character interrupter shaft. When the actuating arm is in the operated position, the character interrupter shaft is rotated to position the character interrupter pawl in the path of the cycle clutch link. This prevents the cycle clutch from releasing. (Fig. 9)

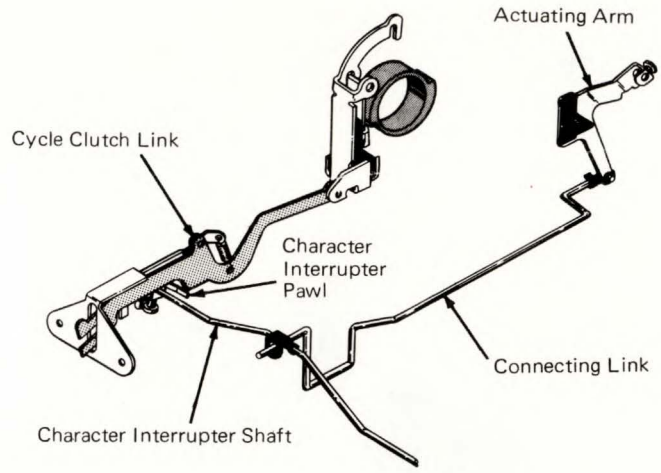


Figure 9 – Carrier Return/Print Interlock

CARRIER RETURN ADJUSTMENTS

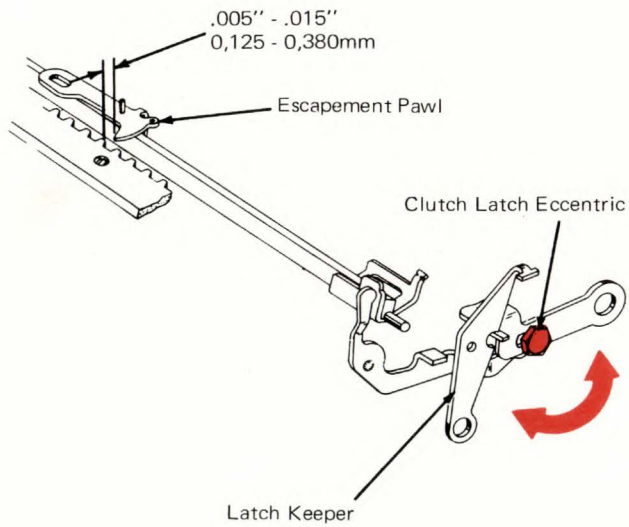
Note: All operational control adjustments must be correct before attempting to make carrier return adjustments.

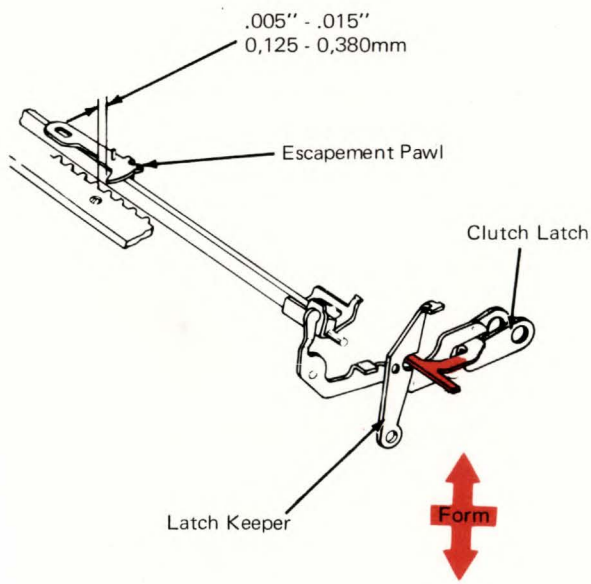
Level 1 machines can be identified by the presence of the clutch latch eccentric in the carrier return clutch latch. Level 3 machines can be identified by a 90 deg. bend in the left hand end of the clutch latch shaft. All others are level 2.

1. *Pawl Clearance (Level 1)* – Adjust the clutch latch eccentric so the escapement pawl will clear the rack teeth by .005"-.015" when the latch is being held down by the keeper. Caution: Do not form the tip of the carrier return clutch latch.

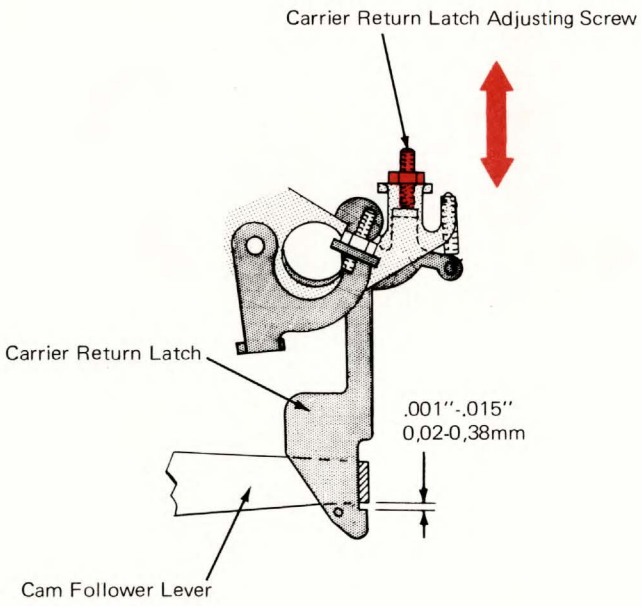
2. *Pawl Clearance (Level 2 and 3)* – Form the tip of the carrier return clutch latch to obtain .005" to .015" between the escapement pawl and the escapement rack when the carrier return clutch latch is held down by the keeper.

   This adjustment assures the escapement pawl will not drag along the escapement rack during a carrier return and that the pawl will be allowed to re-enter the rack quickly at the completion of a carrier return operation.





3. *Carrier Return Latch Height* – Adjust the carrier return latch adjusting screw to obtain .001"-.015" clearance between the latch and the cam follower lever. This adjustment should be made to the low side of the spec to ensure a minimum of lost motion.

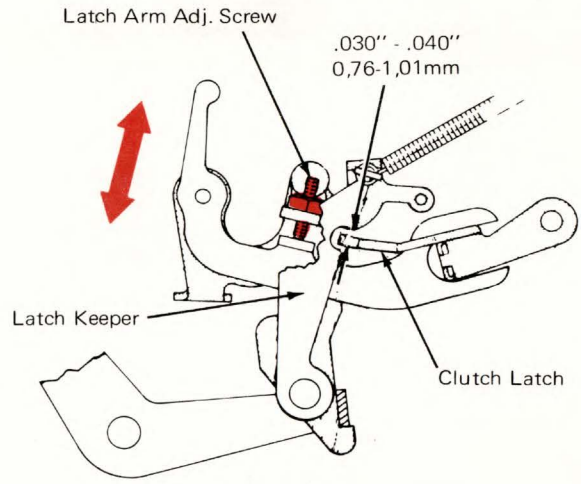


7X1

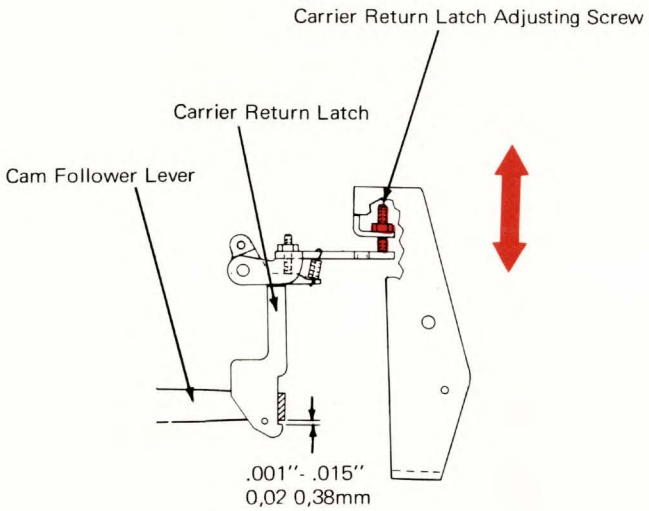
4. *Clutch Latch Overthrow (Level 1 and 2)* – With the carrier return/index cam on the high point, adjust the adjusting screw in the carrier return latch arm to obtain .030" to .040" overthrow between the tip of the carrier return clutch latch and the clutch latch keeper.

Be sure the set screw that locks the carrier return lever to the pivot shaft is tight as this will cause insufficient carrier return latch overthrow.

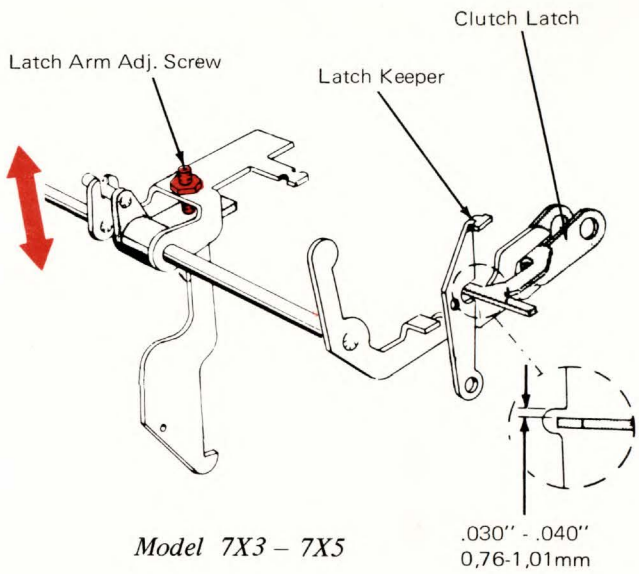
Note: This adjustment should be made with the platen, deflector and feed rolls in the machine. After making this adjustment, be sure to recheck the carrier return latch height adjustment. This can be found in the operational control and space bar section.



Model 7X1

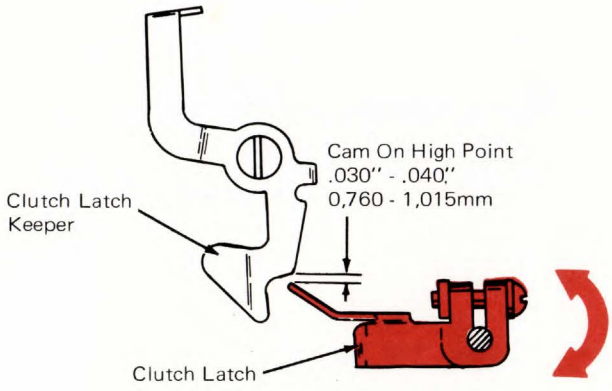


7X3–7X5

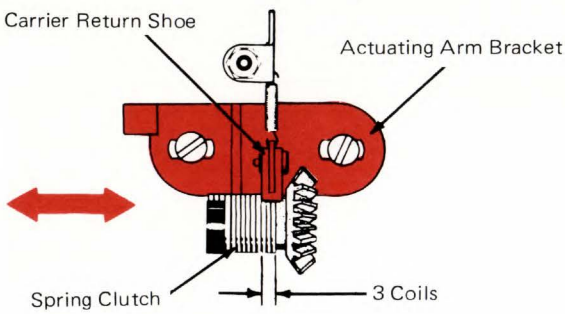


Model 7X3 – 7X5

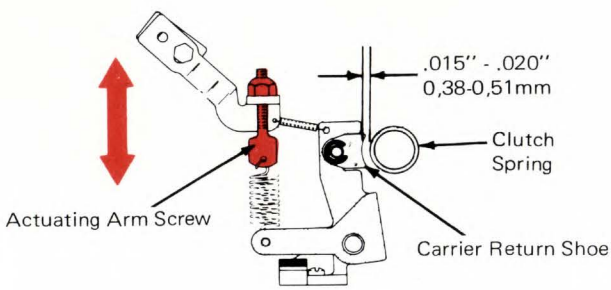
5. *Clutch Latch Overthrow (Level 3)* – With the carrier return/index cam on the high point and the platen, deflector and feed rolls in the machine, rotate the clutch latch on the clutch latch actuating shaft to obtain .030" to .040" clearance between the carrier return clutch latch and clutch latch keeper.



6. *Carrier Return Shoe Overlap* – Adjust the carrier return actuating arm bracket left or right so the carrier return shoe overlaps the last three coils on the right hand end of the carrier return clutch spring. This ensures that all coils of the clutch spring will be used in the clutch operation.

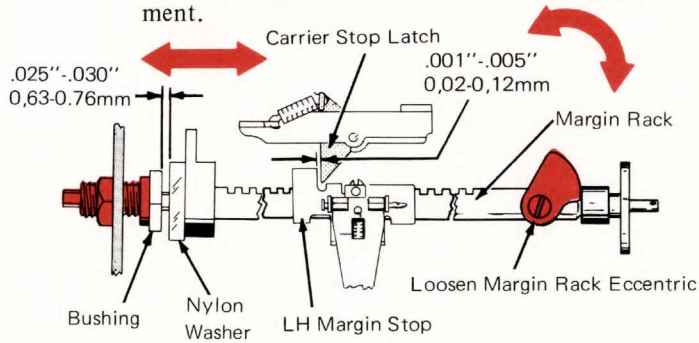


7. *Carrier Return Shoe Clearance* – Adjust the actuating arm spring screw vertically to obtain .015" to .020" clearance between the carrier return shoe and the carrier return clutch spring with all parts at rest.



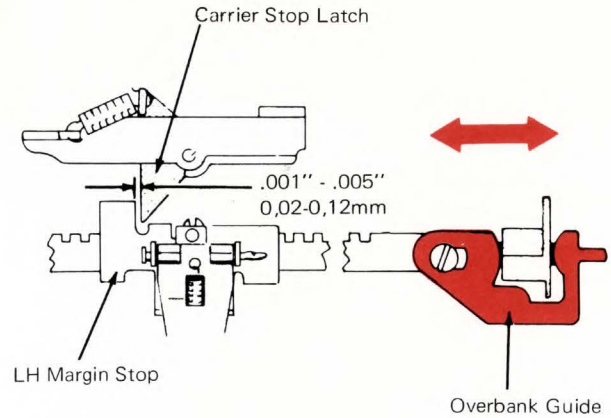
8. *Overbank (Early Level)* – With the carrier at the left hand margin, adjust the margin rack eccentric to obtain .001" to .005" clearance between the left hand margin stop and the carrier stop latch. Next, adjust the bushing at the left hand end of the margin rack to obtain .025" to .030" between the bushing and the nylon washer.

Note: Any change in overbank on machines equipped with this old-style margin rack assembly will directly affect the clutch unlatching adjustment.



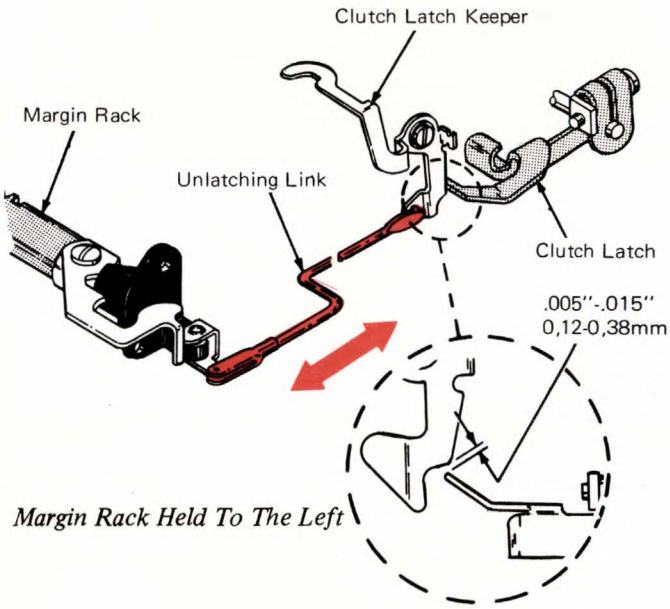
9. *Overbank (Late Level)* – With the carrier resting at the left hand margin, adjust the overbank guide left to right to obtain .001" to .005" clearance between the left hand margin stop and the carrier stop latch. On machines equipped with the floating stop latch, the floating action of the latch must be removed by pulling the latch to the right with a spring hook before this clearance can be observed.

The adjustment of the overbank guide on the margin rack determines the rest position of the margin rack. This adjustment ensures that the left hand margin stop will set accurately when the stop is moved to the right against the carrier. The adjustment of the overbank guide, plus the amount of lateral motion that the guide permits, automatically provides the carrier with the overbank required for proper escapement pawl re-entry at the completion of a carrier return operation.



10. *Clutch Unlatching* – With the power on, hold the clutch latch down. The carrier return latch keeper should clear the tip of the carrier return latch by .005" to .015" at the unlatching point. Lengthen or shorten the carrier return unlatching link to obtain this clearance.

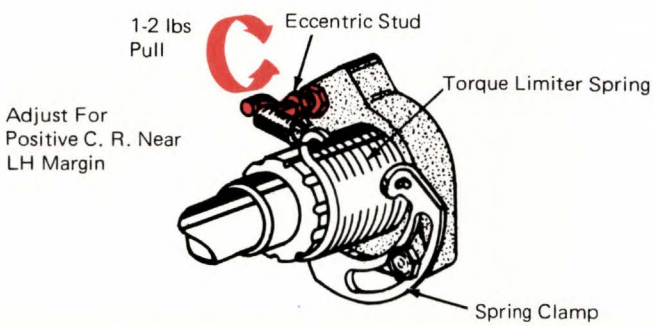
Note: On machines equipped with the early style margin rack, check the margin rack eccentric adjustment if the clutch fails to latch properly. The eccentric may be holding the rack too far to the left restricting the margin rack motion and reducing the amount of bite that the keeper may take on the latch.



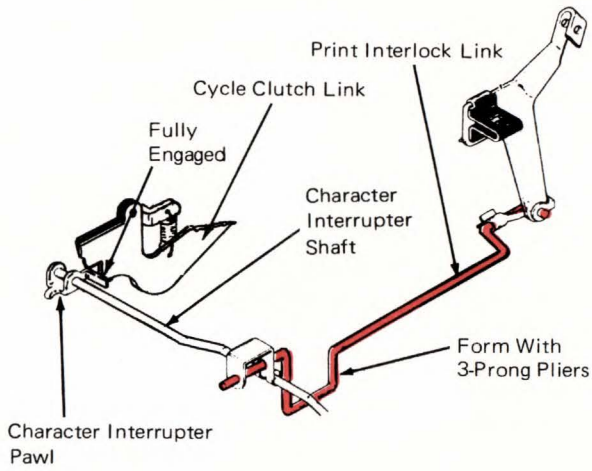
Margin Rack Held To The Left

11. *Torque Limiter* – Adjust the eccentric stud on the torque limiter hub to provide one to two pounds pull on the carrier as the carrier is unlatching the clutch at the left hand margin. If sufficient adjustment is not available at the eccentric, the torque limiter spring may be shifted on the torque limiter hub by repositioning the torque limiter spring clamp.

If no spring scale is available, the torque may be estimated by holding the carrier while the clutch is engaged. The torque limiter should slip readily yet return the carrier positively without any hesitation when the carrier is released.



12. *Carrier Return Print Interlocks* – Form the carrier return print interlock link to satisfy the following conditions. With the carrier return clutch latched, the character interrupter pawl should fully engage in front of the cycle clutch link. With the carrier return mechanism at rest, the interlock link must not restrict the character interrupter shaft from returning to rest.



The print mechanism moves the typehead toward the platen and returns it to rest. There are two basic conditions necessary for correct print operation. They are: Correct velocity of the typehead as it strikes the paper, and proper platen position.

The print mechanism contains an impression control lever which may be positioned to one of five settings to permit operator to change the overall impression of the typehead. An automatic velocity selection mechanism is also employed to provide a lighter impression for the periods, commas, colon, semi-colon, quotation mark, apostrophe, hyphen, and underscore; regardless of where the impression control lever may be set. (Fig. 1)

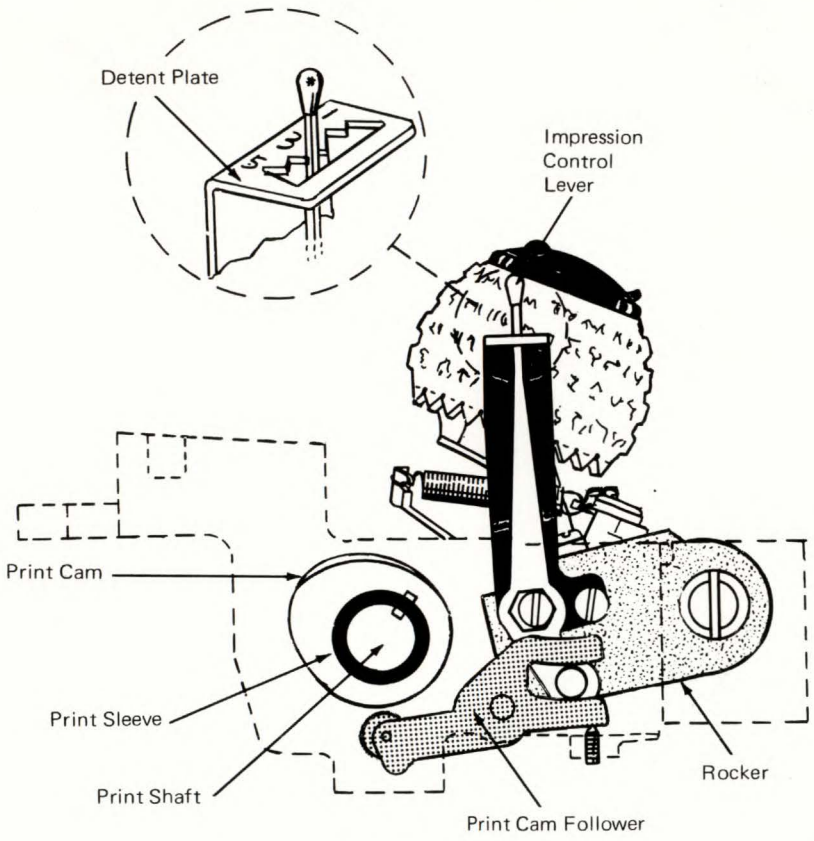


Figure 1 – Impression Control Mechanism

This is accomplished by using a print cam that has two different camming surfaces. The low and high points of both camming surfaces are identical. The only difference is in the contour between their low and high points. The contour of one camming surface provides the typehead with a lower impact velocity than the other. The difference in typehead velocities produced by the two camming surfaces remains proportional between all settings of the impression control lever. (Fig. 2)

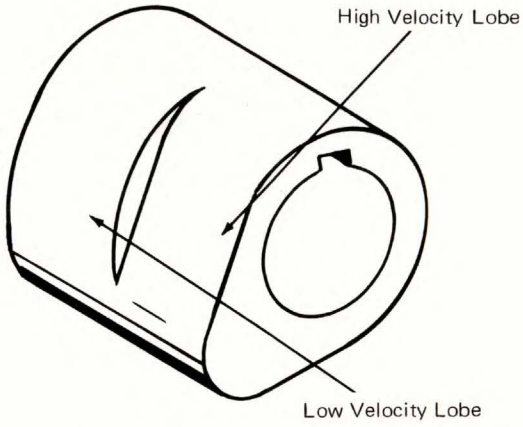


Figure 2 – Print Cam (Dual Velocity)

The print cam follower has a roller mounted on a pin and is free to slide left to right to select the desired velocity lobe. The camming surface or lobe on the print cam that produces the greatest impact velocity is called the high velocity lobe. This is the right hand lobe on the print cam. The left hand lobe, producing less impact velocity, is called the low velocity lobe. (Fig. 3)

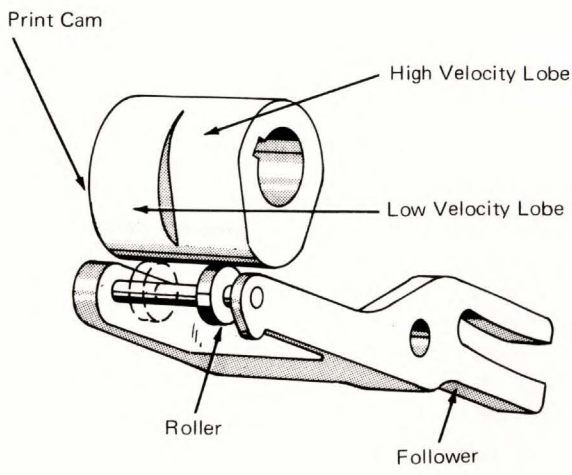


Figure 3 – Print Cam Follower Assembly

The roller is positioned left to right under the desired cam lobe by a roller yoke that straddles the roller. A lever, called the yoke actuating lever, controls the lateral position of the yoke and roller. It mounts on the tab cord anchor bracket by a shouldered rivet. The yoke actuating lever is spring loaded at the rear and maintains the rest position of the roller directly beneath the high velocity lobe of the print cam. (Fig. 4)

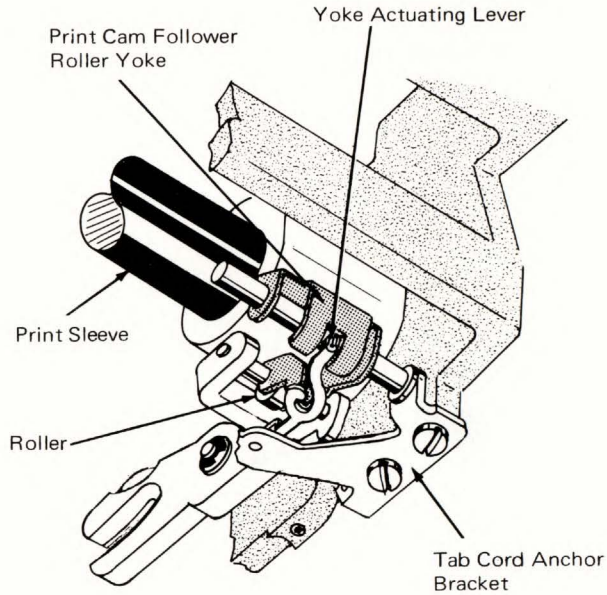


Figure 4 – Print Cam Follower Roller Yoke

A sheathed cable called the velocity control cable fastens to the yoke actuating lever. Whenever a pull is produced on the velocity control cable, the yoke actuating lever and roller yoke will shift the print cam follower roller from the high velocity lobe to the low velocity lobe of the print cam. When the pull on the velocity control cable is relaxed, the yoke actuating lever spring shift the roller back to its position beneath the high velocity lobe of the print cam. (Fig. 5)

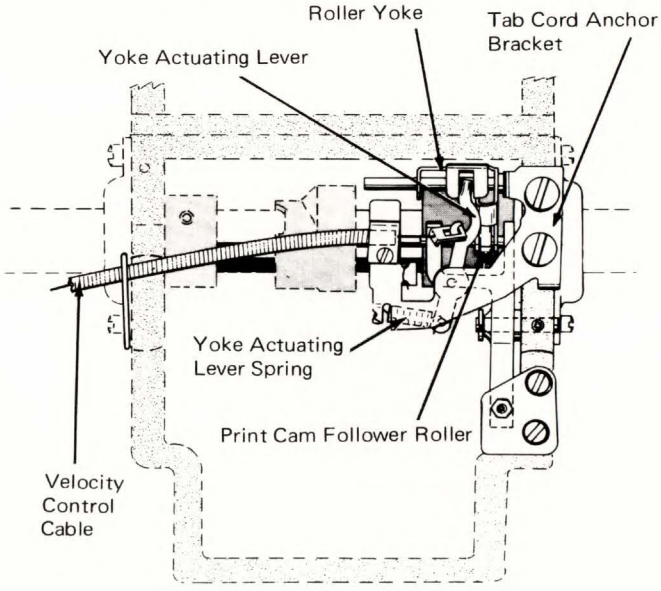
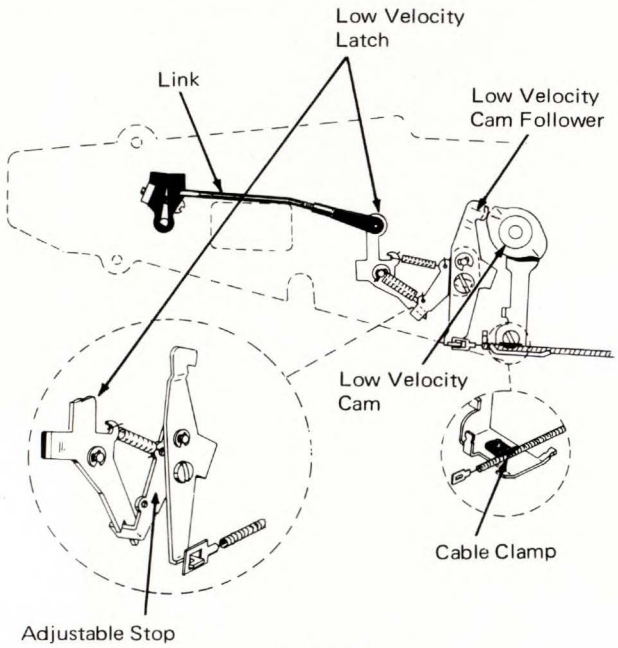
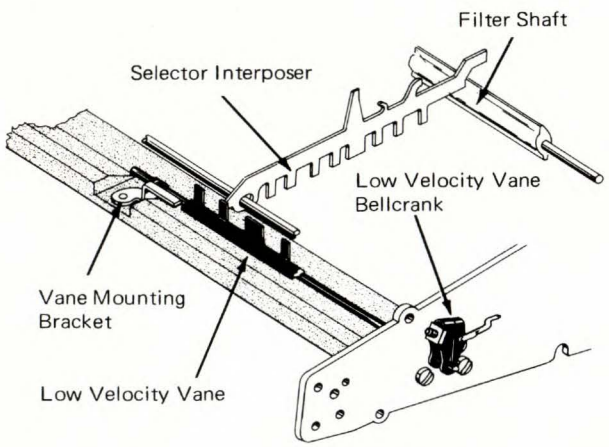


Figure 5 – Yoke Actuating Lever And Spring

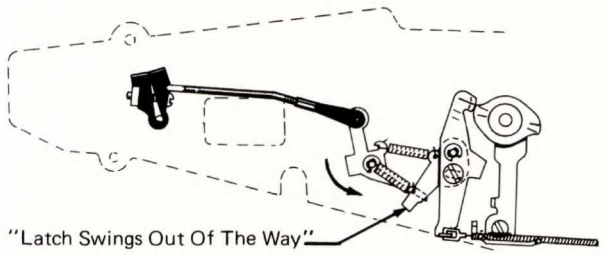
When a low velocity character is selected, a pull on the velocity control cable is produced to shift the roller to the low velocity lobe on the print cam. A low velocity vane is mounted in the keyboard in a position to be contacted by the selector interposer as it is driven forward by the filter shaft. Attached to the right end of the low velocity vane is the low velocity vane bellcrank. Rotation of the vane and bellcrank creates a pull on the link causing the low velocity latch to rotate counterclockwise about its mounting stud. As the latch rotates, it pivots out of the operating path of the adjustable stop attached to the low velocity cam follower. The low velocity cam follower is spring loaded against the low velocity cam. With the low velocity latch removed from its operating path, the cam follower will travel to the low dwell of the low velocity cam and create a pull on the velocity control cable. (Fig. 6)



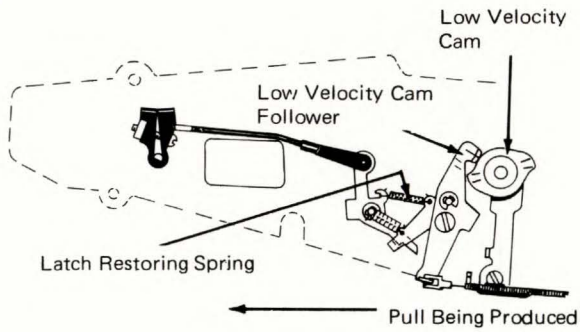
A – Machine At Rest



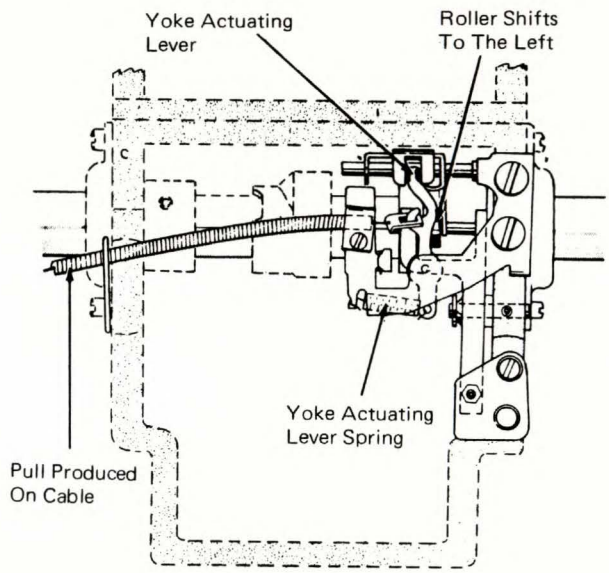
B – Low Velocity Selection



C – Beginning Of A Low Velocity Operation



D – Low Velocity Operation



E – Roller Shift Operation

Figure 6 – Low Velocity Sequence

If a high velocity character is selected at the keyboard, the low velocity latch will remain at rest in the operating path of the stop on the cam follower. The cam follower is restricted from following the contour of the cam and no pull is felt on the velocity control cable. The print cam follower roller remains to the right under the high velocity lobe of the print cam and a high velocity print operation results.

To prevent the print cam from interfering with the print cam follower roller as it shifts from one lobe to the other, the print cam follower and roller are held disengaged from the print cam by an adjustable stop screw until the roller has shifted. The stop screw contacts the rear of the print cam follower. The shifting of the roller occurs at the beginning and at the end of a low velocity print cycle which is just as the print cam is leaving or approaching its rest position. (Fig. 7)

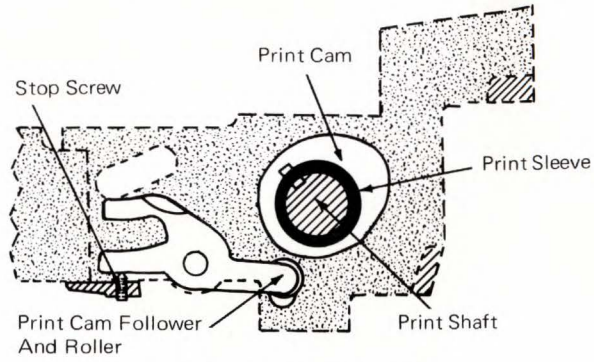


Figure 7 – Print Cam Follower Stop Screw

The impression made by the typehead is determined by the velocity of the typehead upon impact with the paper. By increasing or decreasing the velocity of the typehead with the impression control lever, the impression for all characters can be changed equally regardless of automatic velocity selection. The impression control lever may be positioned by the operator to one of five different impression settings. Changing the position of the impression control lever causes a pin in the lower part of the lever to move front to rear in the forked slot of the print cam follower. The front to rear position of the pin determines the amount of powered travel that the typehead receives from the print cam follower. This plus the amount of free flight or typehead movement from the high point of the print cam to the platen determines the velocity of the typehead upon impact with the paper. (Fig. 8)

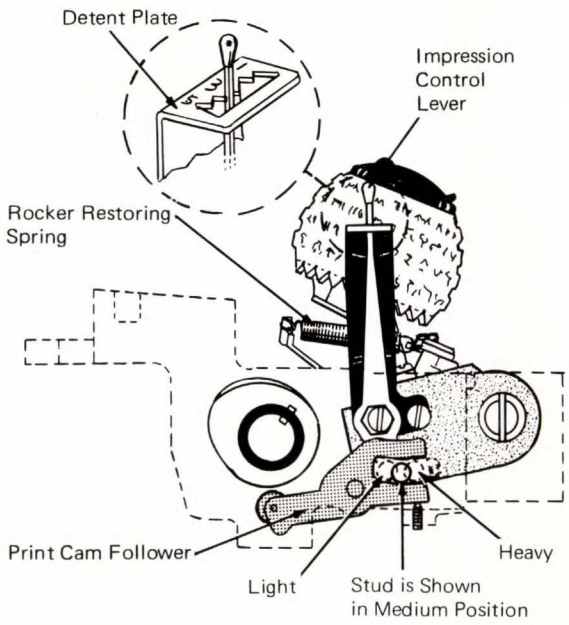


Figure 8 – Impression Control Mechanism

When the impression control lever is pulled forward, the pin on the lower extension moves toward the rear in the forked slot of the cam follower and increases the amount of powered travel that the typehead will receive. This is accomplished by changing the rest position of the typehead and not as a change in the amount of free flight. (Fig. 8)

To prevent smearing and alignment problems, long carriage machines are equipped with a carrier support to prevent flexing of the print shaft. The support is mounted to the power frame just below the front of the carrier. The bottom of the carrier pad serves as a buffer. (Fig. 9)

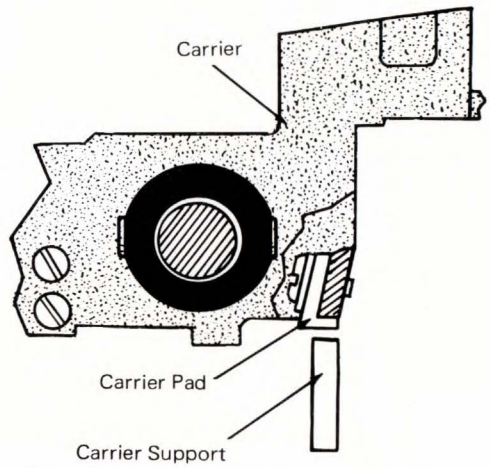


Figure 9 – Carrier Support (723-725)

The quality of typed impression is determined to a large extent by the condition of the platen. Platen rubber may be adversely affected by numerous factors such as light, heat, chemicals, etc. An old or worn platen may be considerably harder than a new platen and may also vary slightly in diameter. The machine is equipped with a platen with a hardness density comparable to the number 2 platen used with the standard IBM Electric Typewriter. (Fig. 10)

The platen is held in position in the machine by a latch pivoted at the front of each carriage end plate. The platen may be removed by pressing the rear of the latches down and lifting the platen out. It may be re-installed by snapping it into position without depressing the latches, however, care must be taken to prevent bending the platen shaft. Also, releasing feed roll tension will aid in re-installation of the platen.

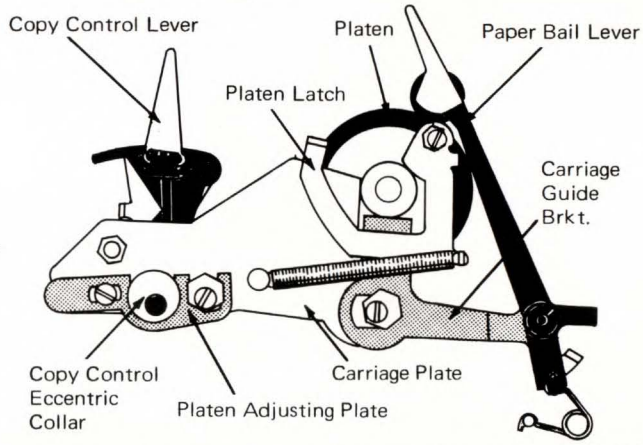


Figure 10 – Copy Control Mechanism

The copy control mechanism positions the platen front to rear for different thicknesses of typing material. The copy control mechanism is operated by a lever located at the left end of the carriage. The lever is attached to a shaft that extends through the sides of the powerframe. An eccentric collar attached to each end of the shaft operates between adjusting plates attached to the carriage end plate. As the lever is moved to the rear, the shaft rotates causing the eccentric collars to force the carriage plates to the rear. The platen and entire paper feed mechanism move with the carriage plates. When the copy control lever is pulled forward, the eccentric collars contact the platen adjusting plates and force the carriage forward into the normal position. The copy control lever can be set in five different positions. A spring detent attached to the power frame acts against a knob on the copy control lever to hold it in place. (Fig. 10)

Early level machines did not have the automatic velocity control mechanism. The impression was a preset adjustment and could not be changed by the operator. (Fig. 11)

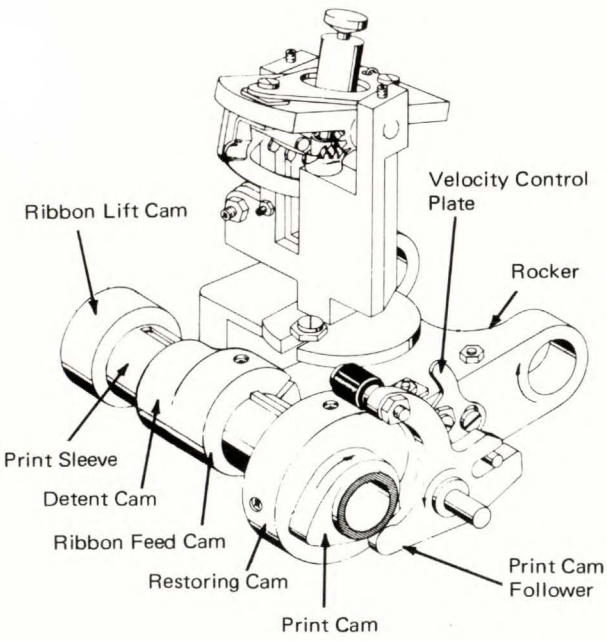


Figure 11 – Print Mechanism

(Early Level)

The print cam is a double cam. Its function is to power the typehead toward the platen and restore it to rest. A small camming surface on the right is the print cam and moves the typehead toward the platen. A larger camming surface on the left is called the restoring cam. It restores the typehead to rest and prevents it from rebounding. (Fig. 12)

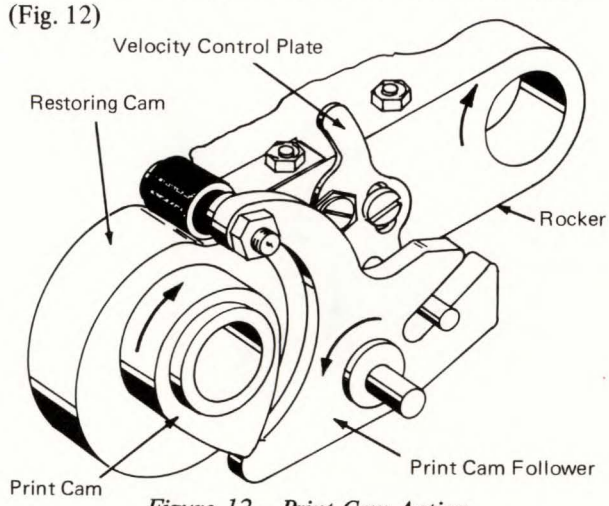


Figure 12 – Print Cam Action

The camming surface of the print cam is designed so the typehead is powered within a few thousands of an inch of the platen. Because the typehead is powered nearly all the way to the platen, all the characters are forced to emboss the paper slightly, even those with a large surface area. To restrict the amount of free flight of the typehead so embossing will be the same for all characters, a heavy arm called the anvil striker is attached to the bottom of the carrier and acts as a stop for the rocker. Just under the front of the carrier and extending between the side frames is an anvil. It is an angle-shaped bar with the lip extending to the rear. As the typehead embosses the paper to the correct depth, the striker hits the bottom of the anvil and prevents further travel of the rocker and typehead. This means that the impression for each character will be consistent with little variation between characters. (Fig. 13)

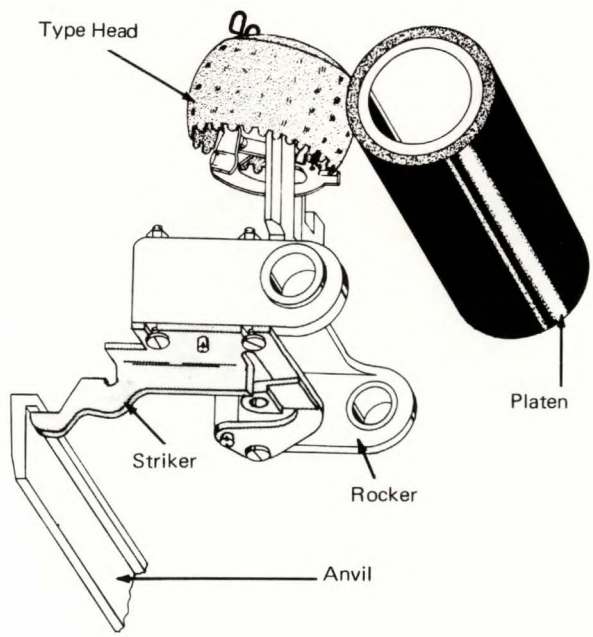
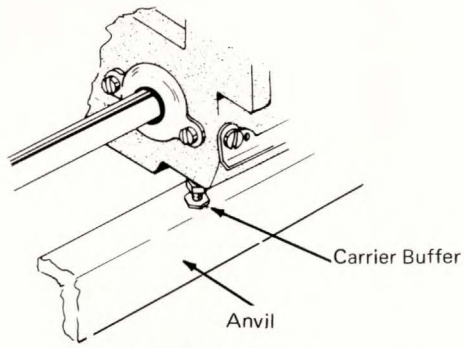
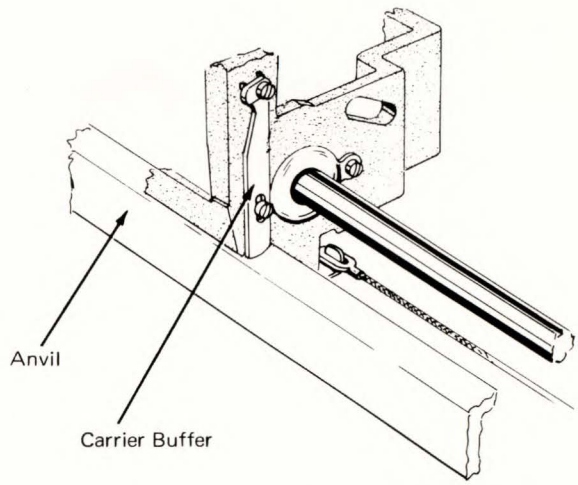


Figure 13 – Anvil And Striker

Whenever the carrier prints in the middle of the writing line on long carriage machines, downward flexing of the print shaft occurs resulting in a loss of impression. Carrier buffers located on each side of the carrier casting, limit this flexing action by operating against the top surface of the anvil. (Fig. 14)



(Left Side)



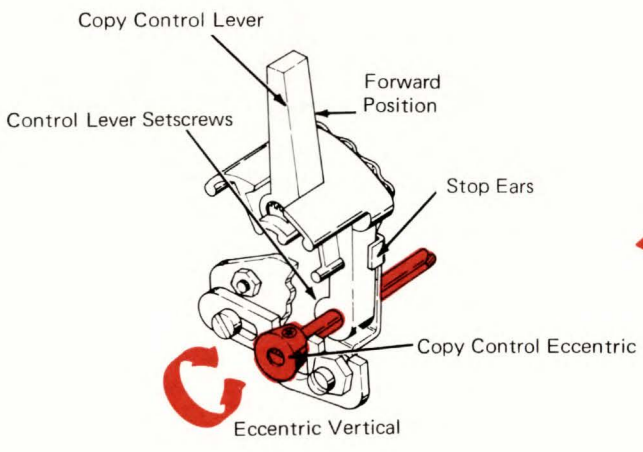
(Right Side)

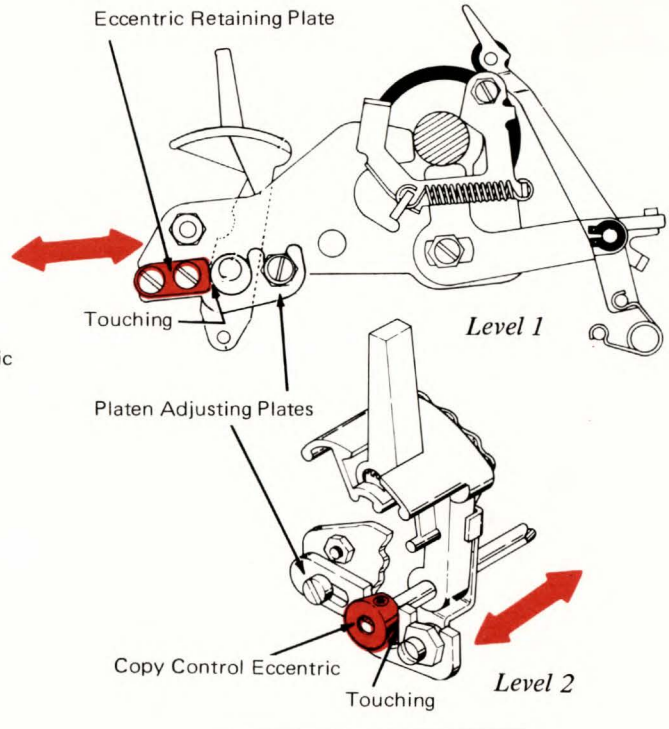
Figure 14 – Carrier Buffers (Long Carriage)

PRINT OPERATIONAL CONTROL ADJUSTMENTS

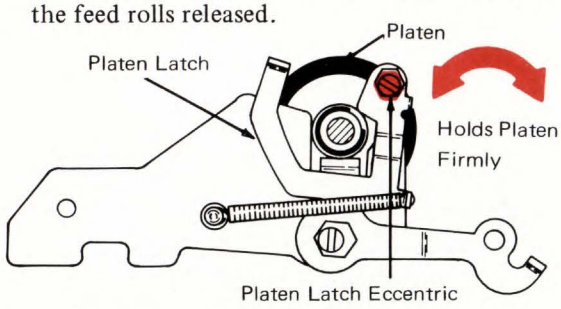
1. *Copy Control Lever* – With the copy control lever detented in the forward position, the high point of the eccentric should be up. Loosen the control lever setscrews and rotate the shaft to satisfy this condition. The stop ears on the copy control detent spring should be formed to provide positive detenting in the extreme front and rear positions of the lever.

2. *Platen Adjusting Plates* – Adjust the eccentric retaining plates front to rear on level 1 machines or the copy control eccentric left to right on level 2 machines so there is no front to rear motion and no binds exist between the eccentric and the platen adjusting plates on each side of the machine.



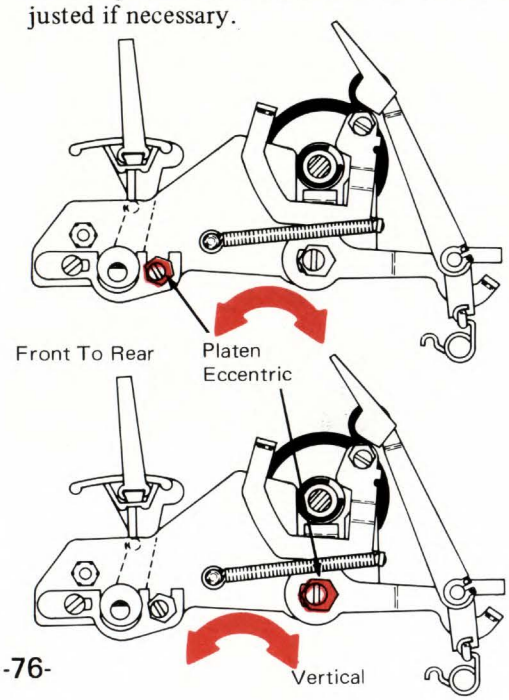


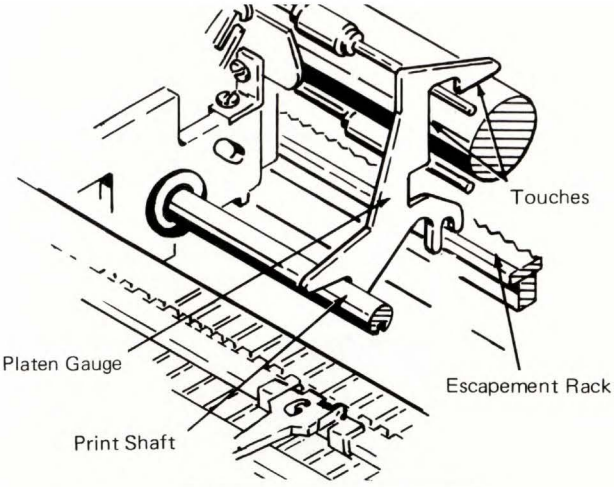
trics, with the high part down, so the platen is held firmly in position vertically and horizontally. The latches should latch and unlatch freely with the feed rolls released.



4. *Platen Position* – To properly adjust the print mechanism, the correct position of the platen must be established first and then the print adjustments made relative to the platen position. With the copy control lever forward and the print shaft keyway down, loosen the platen eccentrics and move the platen to the extreme rear and as low as possible. Rest the platen gauge on the print shaft and escapement rack at one extreme end of the machine. Adjust the platen front to rear and platen height until the platen just touches the platen gauge. Be certain the gauge maintains proper contact with the print shaft and the escapement rack. Move the gauge to the opposite end of the machine and repeat the procedure. Check for a parallel condition by sliding the gauge back to the beginning end. With the gauge removed, the platen height adjustment should now be refined to provide even top and bottom color of printed characters.

CAUTION: Any change in the front to rear position of the platen necessitates a readjustment of the velocity control plate and anvil on early level machines. Also, any change in the platen position may alter the paper feed adjustments. All paper feed adjustments should be checked and readjusted if necessary.

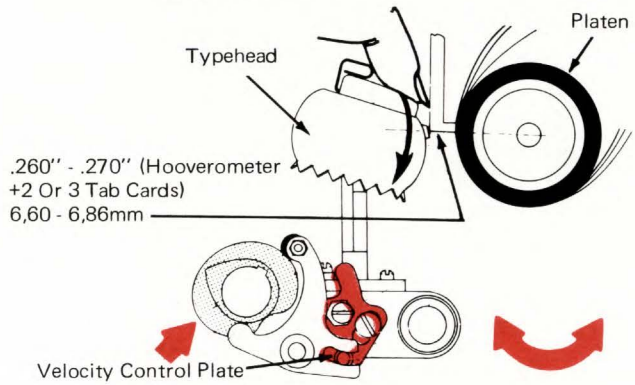




Adjustments 5 through 8 are for early level machines only.

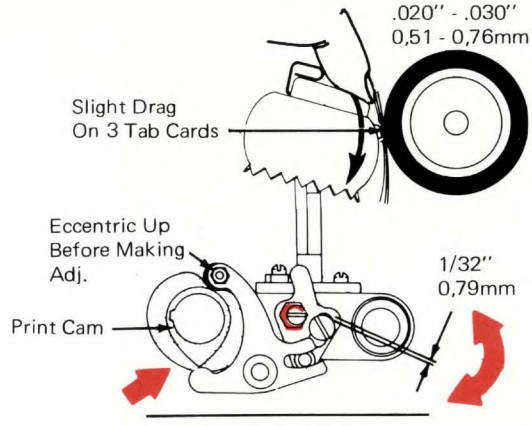
5. *Velocity Control Plate* – The velocity control plate must be adjusted to satisfy the following two conditions.

   a. With the cam follower held lightly against the low point of the print cam, the center of the home character should clear the platen by .260"-.270".



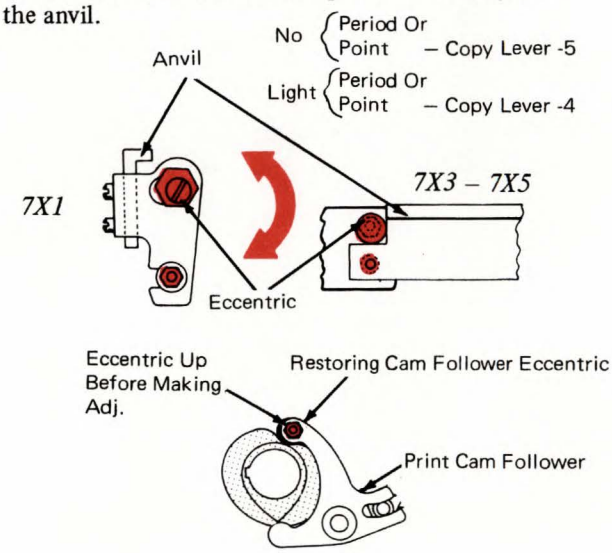
   b. With the cam follower held lightly against the high point of the print cam, the home character should clear the platen by .020"-.030". Be sure the anvil does not restrict the rocker motion.

   NOTE: The adjustments should be checked with the ribbon removed. The .260"-.270" can be gauged with two or three tab cards plus the foot of the Hooverometer handle.

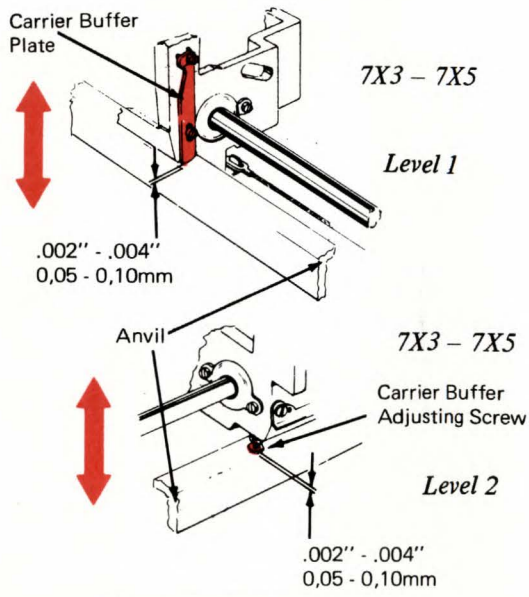


6. *Anvil* – Adjust the eccentric at each end of the anvil to properly restrict the free flight of the typehead. With one sheet of paper installed in the machine, the period should just fail to print with the copy lever all the way back. With the copy lever pulled forward one notch (fourth position), the period should print lightly.

NOTE: The restoring cam follower eccentric should be adjusted all the way up while the anvil is being set. On 7X3 and 7X5 machines, the carrier buffers must also be moved up out of the way of the anvil.

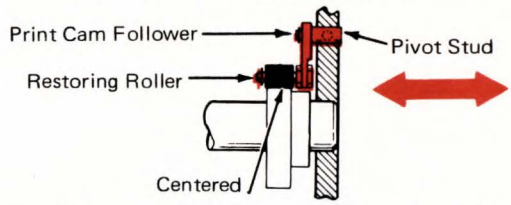


7. *Carrier Buffers* – (7X3 and 7X5 only) – The buffer plate attached to the right side of the carrier and an adjusting screw under the left side of the carrier strike the top of the anvil to prevent the print shaft from flexing downward. Each should have .002"-.004" clearance with the top of the anvil.



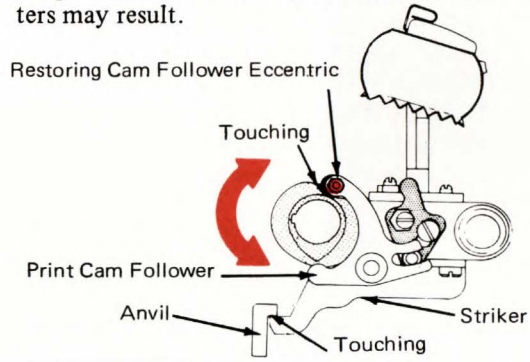
8. *Print Cam Follower* – The print cam follower must be adjusted to satisfy the following conditions:

a. Print Cam Follower Stud – Adjust the pivot stud left to right so the rubber roller on the follower is centered on the surface of the restoring cam. The stud is held in place in the carrier casting by a set screw that is accessible from the bottom of the machine.



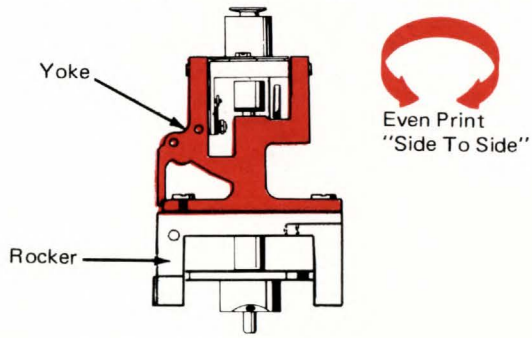
b. Restoring Cam Follower Eccentric – With the print cam follower at the high point of the cam and the platen removed, hold the typehead toward the rear until it is restricted by the anvil and striker. The roller should just touch the restoring cam. Adjust the eccentric, keeping the high point forward, to satisfy the condition.

NOTE: If the roller is too close to the restoring cam, it may bind against the cam during print shaft rotation. If too much clearance exists, the typehead may not be restored as quickly as is necessary and blurred characters may result.



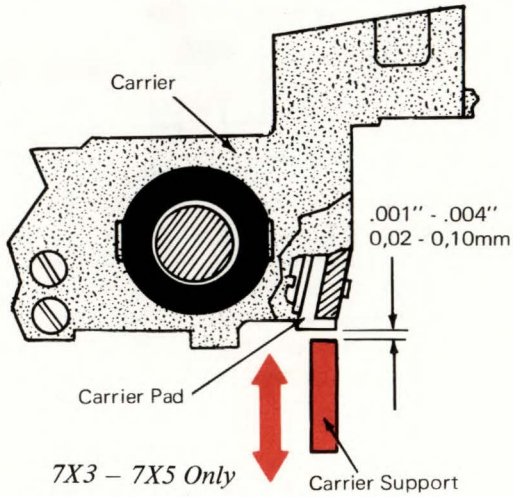
9. *Even Printing* – Position the yoke rotationally under its mounting screws so the density of the left and right sides of a printed character is uniform.

This adjustment will affect the tilt ring homing adjustment, the typehead homing adjustment, and skirt clearance. Be sure to check these adjustments after changing the position of the yoke.

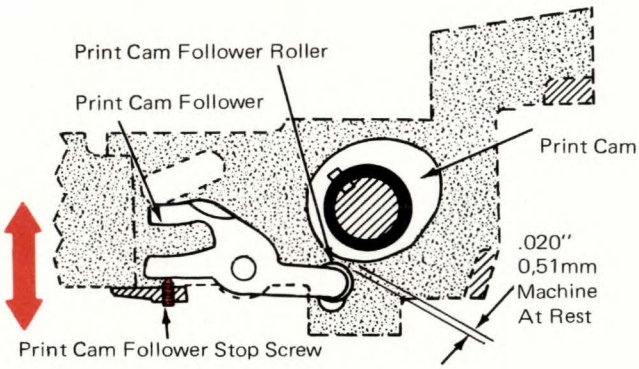


The following adjustments apply only to machines equipped with the dual velocity mechanism.

10. *Carrier Support* – (7X3 and 7X5) – Adjust both ends of the carrier support vertically to obtain .001"-.004" clearance with the bottom of the carrier pad along the entire length of the writing line. The support is secured to the machine power frame by a binding screw at each end.



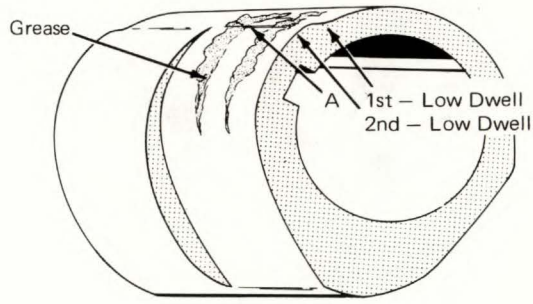
11. *Print Cam Follower Stop Screw* – Adjust the print cam follower stop screw so the print cam follower roller clears the print cam by .020" when the machine is at rest. This clearance allows the roller to shift from one lobe to the other without rubbing on the cam.



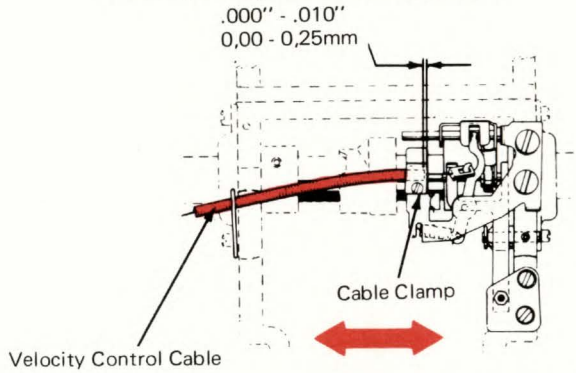
This adjustment may be checked by applying a light film of grease on the print cam and then observing the track that the roller makes in the grease when the machine is hand cycled. If the stop screw has been adjusted properly, the roller track in the grease should begin at point "A" on the print cam. This is the beginning of the second low dwell on the print cam.

If the roller track begins before point "A", the roller is adjusted too close to the print cam when the machine is at rest. Improper roller to cam clearance may cause the roller to drag on the print cam as it shifts during a low velocity selection. Thus, the roller may fail to shift, or shift improperly. Also, if the roller is adjusted too close to the cam at rest, it may receive a ski-jump effect from the print cam as it attempts to follow the print cam from the first low dwell to the second low dwell. This will create excessive noise and wear along with adverse effect on typehead impact velocity.

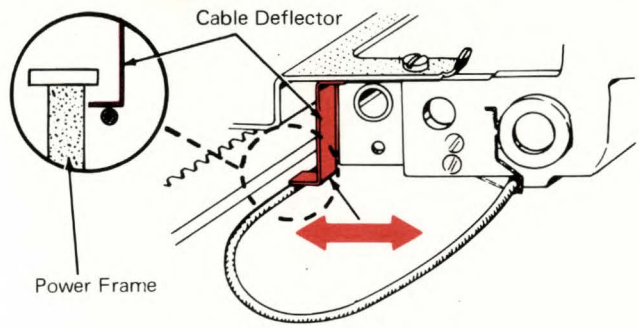
If the roller track begins after point "A", the roller rests too far away from the first low dwell of the print cam and a loss of typehead velocity may result.



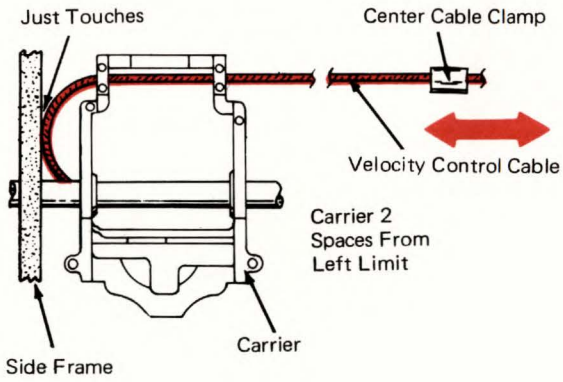
12. *Velocity Control Cable Clamp* – Adjust the cable sheath left to right under the carrier clamp until the end of the sheath is flush to .010" recessed with the right hand edge of the cable clamp. This adjustment prevents the yoke actuating lever from choking off against the cable sheath.



13. *Carrier Cable Deflector* – Form the deflector to the rear as far as possible without touching the power frame.

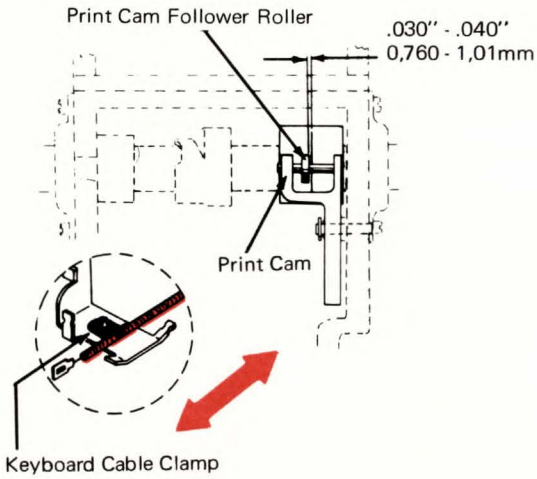


14. *Center Cable Clamp* – Position the cable sheath left to right within the center cable clamp so the bend in the cable will just touch the machine left hand side frame when the carrier is resting two spaces from the extreme left hand margin. This adjustment allows the carrier to operate freely along the entire writing line and allows the velocity control cable to operate with a minimum of flexing.

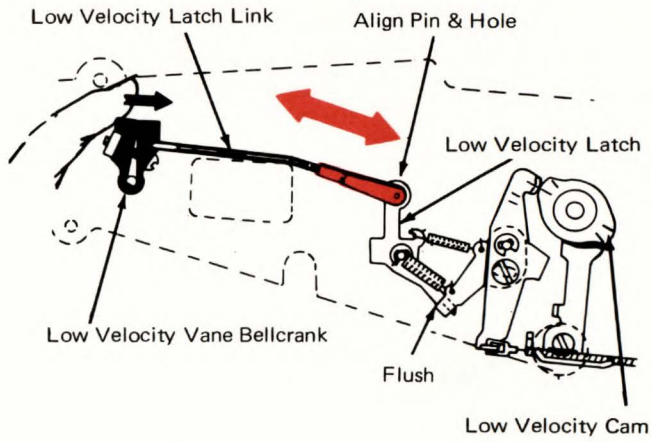


15. *Velocity Control Keyboard Cable Clamp* – Adjust the cable sheath front to rear under the clamp so the print cam follower roller will shift onto the low velocity lobe of the print cam by the width of the roller plus .030"-.040" when a low velocity character is half cycled. Moving the cable sheath to the rear will produce more motion to the roller.

This adjustment should be checked by observing the track of the roller in the grease on the print cam.



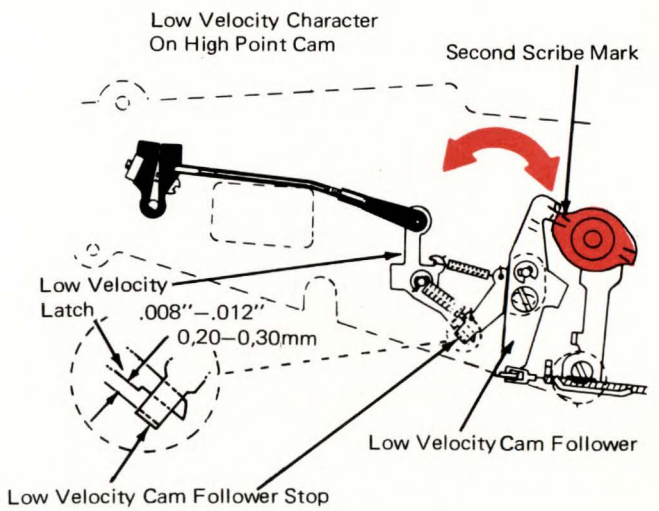
16. *Low Velocity Latch Link* – With the machine at rest, the low velocity latch link should be adjusted to just span the distance between the low velocity vane bellcrank and the low velocity latch. This adjustment ensures the latch will take a full bite on the adjustment stop and there will be no lost motion in the system.



17. *Low Velocity Cam Adjustment* – When a low velocity character is slowly hand cycled, the low velocity latch should clear the adjusting stop on the cam follower by .008"-.012" just as the cam follower scribe mark lines up with the second scribe mark on the low velocity cam. Advance or retard the cam to satisfy this condition.

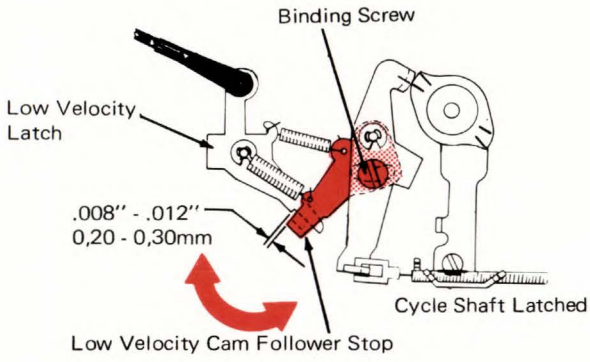
This adjustment can easily be made in the following manner:

a. With the machine at rest, align the first scribe line on the low velocity cam with the scribe line on the cam follower.
b. Hand cycle the machine and observe the .008"-.012" clearance between the latch and stop when the cam follower scribe line is aligned with the second scribe line on the low velocity cam. Refine the cam adjustment slightly to satisfy this condition.



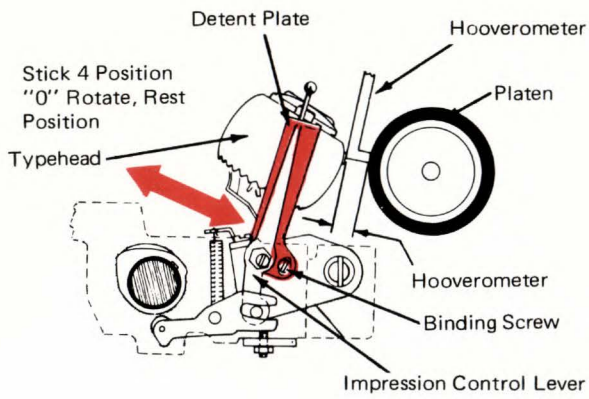
18. *Low Velocity Cam Follower Stop* – With the cycle shaft latched at rest, adjust the low velocity cam follower stop for .008"-.012" clearance with the low velocity latch. Loosen the binding screw and rotate the low velocity cam follower stop to satisfy this condition.

Too little clearance may prevent latching of the low velocity latch resulting in a continuous low velocity operation for all characters. Too much clearance may allow a slight pull to be produced on the cable during a high velocity operation which could shift the roller partially into the low velocity lobe.



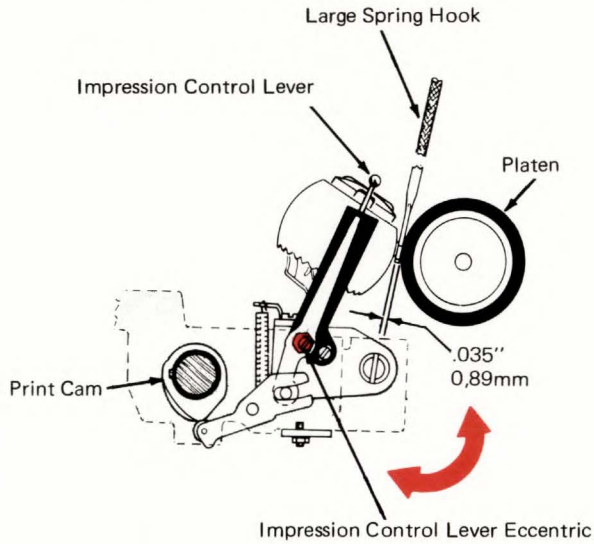
19. *Powered Travel* – With the machine latched at rest and the impression control lever set at position 4, loosen the binding screw and move the detent plate front to rear until the foot of the Hooverometer will just span the distance between the center of the letter "Z" and the platen.

CAUTION: The copy control lever must be positioned all the way forward when making adjustment no. 19 and no. 20.



20. *Free Flight* – With the impression control lever set at 4 and a letter "Z" half cycled until the machine is resting on the high point of the print cam, the pusher end of a large spring hook (.035") should just span the distance between the letter "Z" and the platen. Adjust the eccentric on the impression control lever to obtain this condition keeping the high part of the eccentric forward.

NOTE: Adjustment no. 19 and no. 20 directly affect each other and must be adjusted alternately until both are correct.



In this section we will discuss how the paper is held firmly against the platen, both vertically and horizontally, and how the paper is indexed vertically. First, let's look at the paper feed mechanism.

The paper feed operates by pressing the paper tightly against the platen so that it must move as the platen rotates. The paper is held against the platen by the front and rear feed roll assemblies located beneath the platen. Each feed roll assembly contains three or four rubber rollers equally spaced along the feed roll shaft and molded to the shaft. (Fig. 1)

The feed rolls mount in the front and rear feed roll arm assemblies. The front feed roll arms pivot on the feed roll actuating shaft. Also pivoting on the feed roll actuating shaft is a feed roll arm. There are several holes in the upper extension of the feed roll arm. Heavy extension springs are connected between the carriage tie rod and one of the holes to provide a means of adjusting the feed roll pressure.

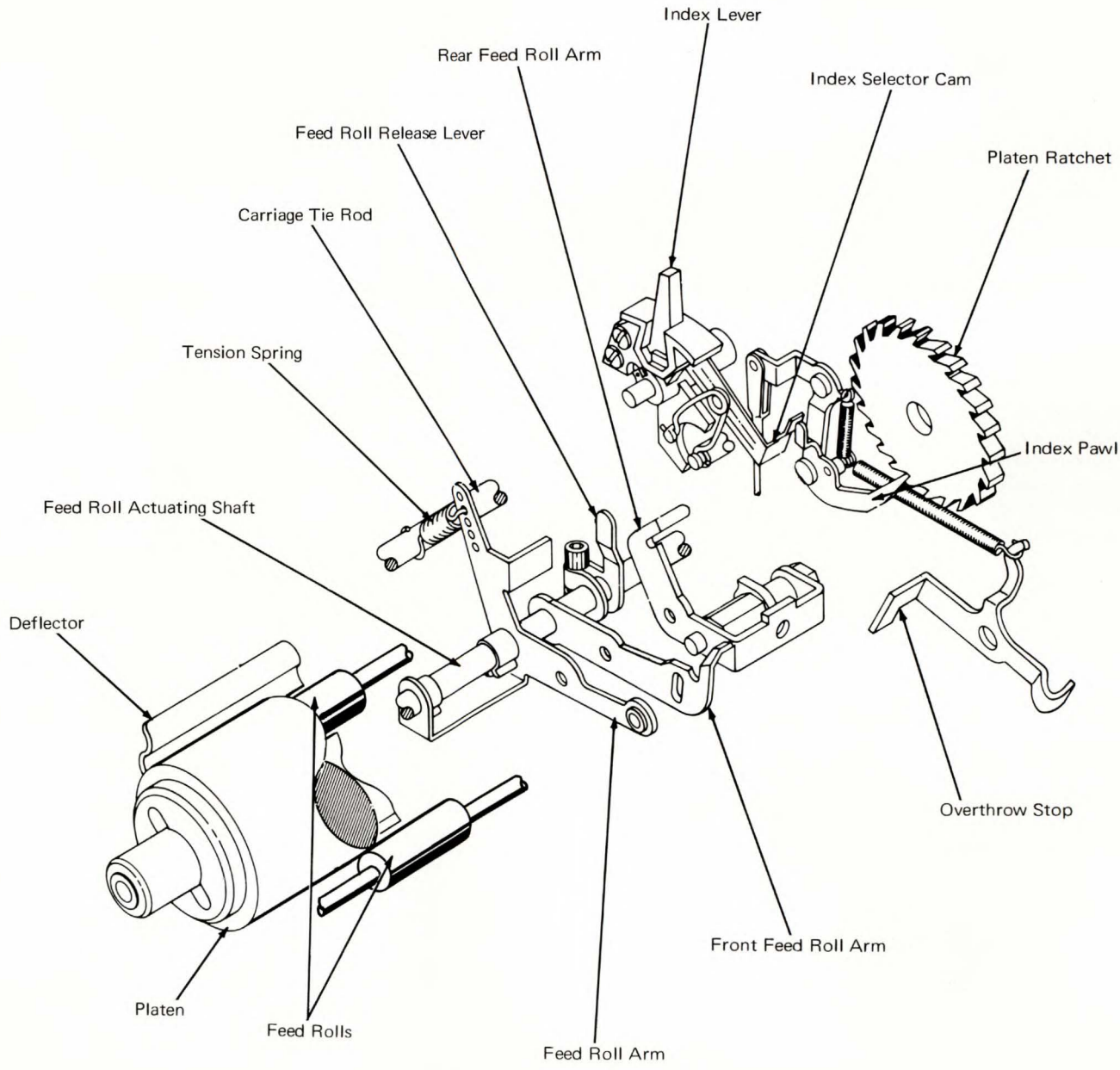


Figure 1 - Paper Feed Mechanism

The paper deflector guides the paper around the platen. It is supported beneath the platen by lugs on the front and rear feed roll arms. A lug at each end of the deflector fits over a stud on the paper feed mounting arm to maintain the correct position of the deflector. (Fig. 2)

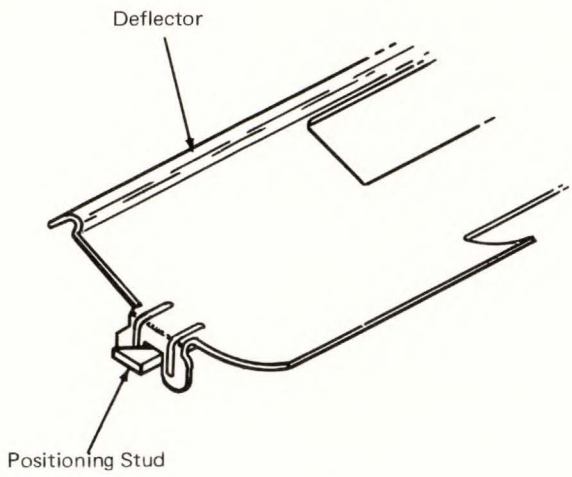


Figure 2 - Deflector Positioning

As the paper is inserted into the machine, an adjustable guide, mounted on the case at the rear of the platen, serves to position the paper for its left margin position. The paper deflector guides the paper between the rear feed roll and the platen. As the platen is turned, the paper is forced to move with the platen. The deflector guides the paper around the platen into position between the front feed roll and the platen. As the paper is fed farther, the end of the paper is guided upward by the cardholder attached to the rear of the carrier. (Fig. 3)

The cardholder assists in holding the typing material against the platen in the printing area. A scale on each side of the cardholder aids the typist in re-inserting material into the machine to a specific printing point. The vertical marks on the scale indicate the middle of the character space and horizontal line indicates the bottom of the writing line. A single mark, located at the top of the cardholder, indicates the middle of the next character to be typed.

Above the writing line, the paper is engaged by two rubber rollers mounted on the paper bail. These rollers hold the paper against the platen above the writing line to reduce the possibility of over printing on the paper. The rollers are also used to feed the paper vertically after the bottom of the paper has left the front feed rolls.

The paper bail is supported by a lever at each end and pivots front-to-rear. A hair pin spring attached to each bail lever, serves as a toggle to hold the bail rolls either to the rear against the platen or forward in the release position.

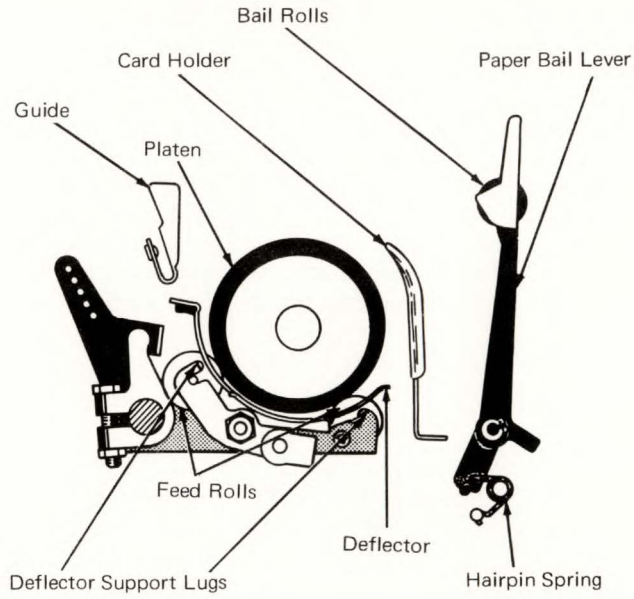


Figure 3 - Paper Feed (L.H. End View)

The pressure of the feed rolls is released from the platen to allow the operator to position the paper more accurately and to allow easier insertion and removal of the paper. Paper release is accomplished by pulling forward on the paper release lever located at the right end of the machine. The front of the paper release lever cams the feed roll release arm forward to rotate the feed roll actuating shaft. The feed roll release levers are clamped to the feed roll actuating shaft and rest behind a lug of each front feed roll arm. As the shaft rotates, the feed roll release levers rotate the front feed roll arms down, away from the platen. Due to the inter-connection between the front feed roll arm and the rear feed roll arm, the rear feed roll arms are forced away from the platen. When the paper release lever has been pulled all the way forward, the end of the feed roll release arm detents to hold the feed roll release lever in the released position. (Fig. 4)

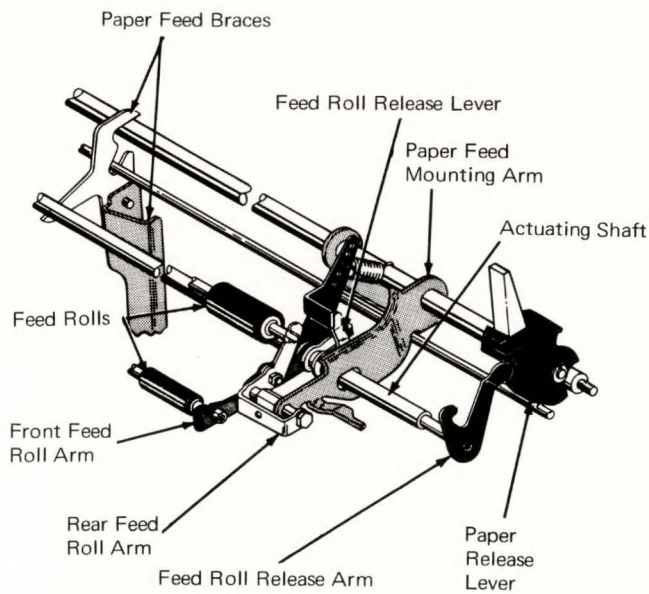


Figure 4 - Paper Release Mechanism

The index mechanism indexes the paper vertically. An index operation can be obtained by depressing either the carrier return keylever or the index keylever. Depressing the carrier return keylever also causes the carrier to move the left margin, whereas depressing the index keylever causes only an index operation.

The index mechanism is operated from the cam follower by means of a multiplying lever and the index link. The rear of the multiplying lever is always in contact with the multiplying lever stop attached solidly to the power frame. The index pawl carrier link always receives the same amount of motion each time the cam operates regardless of the position of the index lever. (Fig. 5)

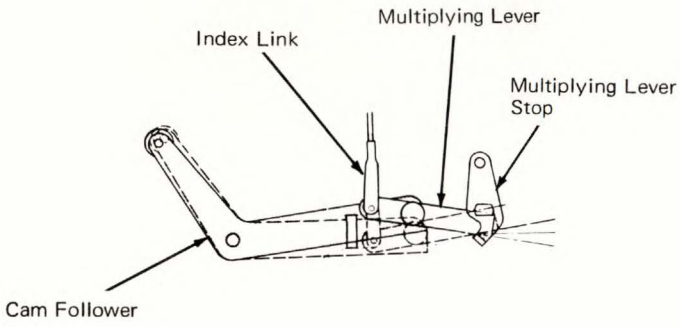


Figure 5 - Multiplying Operation

The index selection lever is held in the single or double space position by a toggle hair pin spring. The index selection lever movement is restricted by two extensions at the bottom of the lever, that contact the hairpin spring mounting stud. (Fig. 6)

During the double space position, the index pawl is allowed to enter the platen ratchet immediately. The index pawl then forces the ratchet forward two spaces until the pawl contacts the platen overthrow stop. The platen overthrow stop wedges the pawl into the ratchet teeth to lock the platen in position.

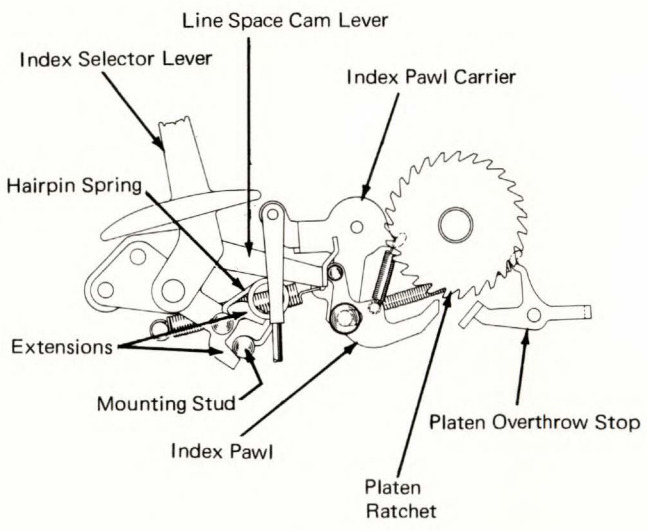


Figure 6 - Index Selection Mechanism (Double Space Position)

If only a single space operation is desired, the index pawl must be prevented from entering the ratchet until it has passed one tooth of the ratchet. The remaining travel after the index pawl enters the ratchet is only sufficient to cause one tooth of rotation to the platen. The index pawl contacts the platen overthrow stop at the end of this stroke as on the double space operation. (Fig. 7)

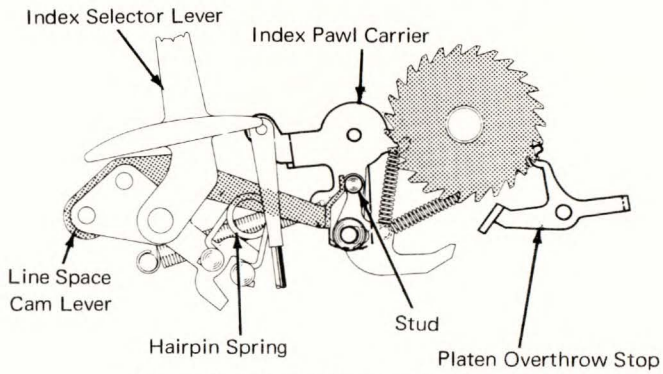


Figure 7 - Index Selection Mechanism (Single Space Position)

The index pawl entry into the platen ratchet is controlled by the line space cam lever located on the index lever. The line space cam lever has two steps at the forward end, in a position to contact a stud on the side of the index pawl. The index pawl is spring loaded toward the platen. With the index lever in the double space position, the index pawl rests near the platen ratchet. In the single space position, the index pawl stud maintains contact with the line space cam lever longer and delays the entry of the pawl into the platen ratchet.

The index pawl is designed with an elongated pivot hole so that it "floats" forward during a portion of the index stroke. As the index mechanism operates, the pawl engages the ratchet tooth. There is a slight delay until the pawl carrier reaches the end of the elongated slot in the index pawl. Because the pawl carrier is operated so sharply the platen is caused to move ahead of the index stroke. Without the elongated hole in the index pawl, the platen ratchet would reach the final position ahead of the index pawl. This is prevented by the pawl moving with it and reaching the overthrow stop at the same time the platen reaches the final position. The pawl is then able to wedge into the ratchet and block any further rotation caused by the momentum of the platen. (Fig. 8)

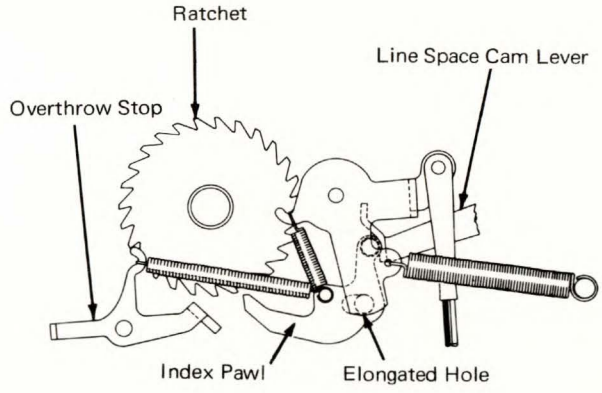


Figure 8 - Index Pawl Operation

The 54 tooth index mechanism operates basically the same as the mechanism just described. However, there are three positions for the index lever. The line space cam lever has an elongated hole with three detent positions on the lower side. An adjustable stud, mounted on the index bracket, detents the line space cam lever to control index pawl entry into the platen ratchet. This permits feeding two, three or four ratchet teeth to index the platen a space, space and half and two spaces. (Fig. 9)

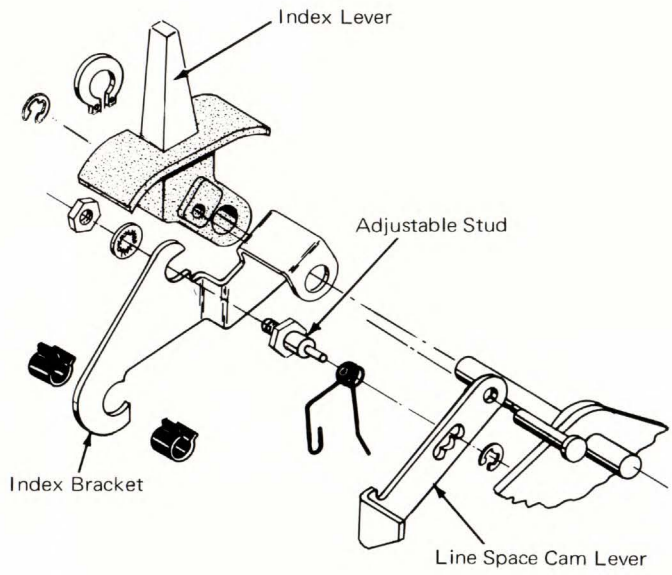


Figure 9 - 54 Tooth Index Mechanism

The left side of the platen ratchet contains two pins that fit into a slot on the platen driver. The platen driver operates left-to-right and always turns with the ratchet. A compression spring between the ratchet and the driver loads the driver to the left so the serrations on the outer surface of the driver mesh with matching serrations inside the platen end plug. The meshing of the serrations cause the platen, the driver, and the ratchet to be locked together and turn as a unit. (Fig. 10)

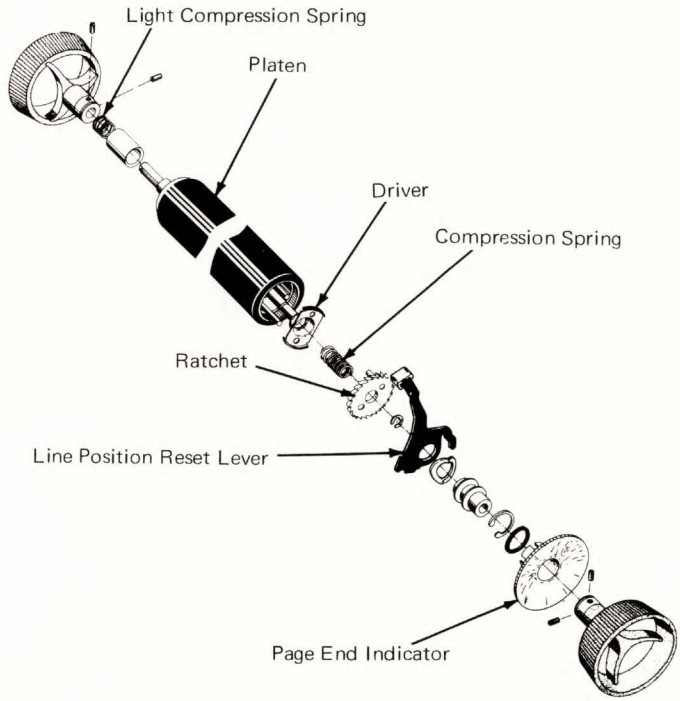


Figure 10 - Platen Assembly

The platen variable mechanism provides the operator with a means of rotating the platen to a position other than the normal writing line. The platen variable is used for typing permanently above or below the writing line or locating the writing line after reinserting the paper. The platen ratchet must remain stationary when selecting a new writing line so that the detent roller will be seated between the two teeth of the ratchet at the new position. A clutch mechanism connects the ratchet to the platen so that it can be engaged for line spacing and disengaged for variable operation. The clutch can be disengaged by pushing the left hand platen knob toward the right, and as long as the platen knob is held to the right, the platen can be rotated freely while the ratchet remains stationary. When the knob is released, the clutch is automatically re-engaged by spring tension. (Fig. 10)

When the driver is disengaged from the platen end plug, the platen can be turned to the desired position. The driver can then engage different serrations and lock the platen in the new position. The left hand platen knob is mounted to a shaft that slides left-to-right inside the platen. A light compression spring holds the shaft toward the right to prevent free play. The shaft pushes against the platen driver. Movement of the platen knob toward the right is transferred to the driver to disengage it from the platen end plug.

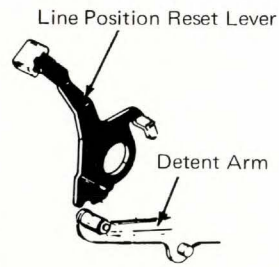


Figure 11 - Line Position Reset Mechanism

The line position reset mechanism, located on the right end of the platen, permits the operator to leave a typewritten line and return again. When the lever is moved forward, the ratchet detent is cammed away from engagement with the platen ratchet. The platen is then free to turn without being detented. Once the operator has made the insertion or correction, she must return the platen to the approximate typing line and return the lever to its home position. This relocates the typing line by allowing the ratchet detent to engage the platen ratchet. (Fig. 11)

The page end indicator, located on the right hand platen knob, allows the operator to judge the typed distance down the page. It is calibrated in half inches. The operator must align the top edge of the paper with the writing line on the cardholder. For a standard size sheet of paper, the operator must rotate the indicator until position 2 is in line with the horizontal mark on the top of the typewriter adjacent to the right platen knob. When using other than standard 11" paper, the operator may locate the indicator setting from the page indicator chart in her operator's manual.

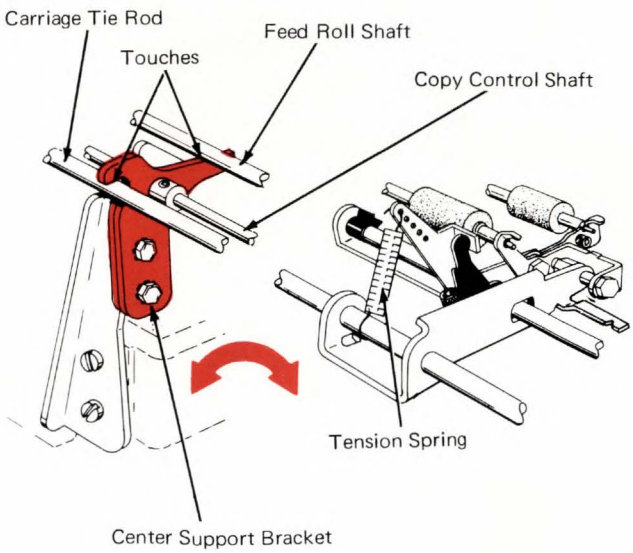
Ready Reference for Page-End Indicator Settings. *This chart recommends the setting for all lengths of paper, ranging from 3 to 14 inches.*

Length Paper	Indicator Setting	Length Paper	Indicator Setting
3"	1	9"	2 1/2
3 1/2"	1 1/2	9 1/2"	3
4	2	10	3 1/2
4 1/2"	2 1/2	10 1/2"	4
5"	3	11	0
5 1/2"	3 1/2	11 1/2"	1/2
6"	4	12"	1
6 1/2"	0	12 1/2"	1 1/2
7"	1/2	13"	2
7 1/2"	1	13 1/2"	2 1/2
8"	1 1/2	14"	3
8 1/2"	2		

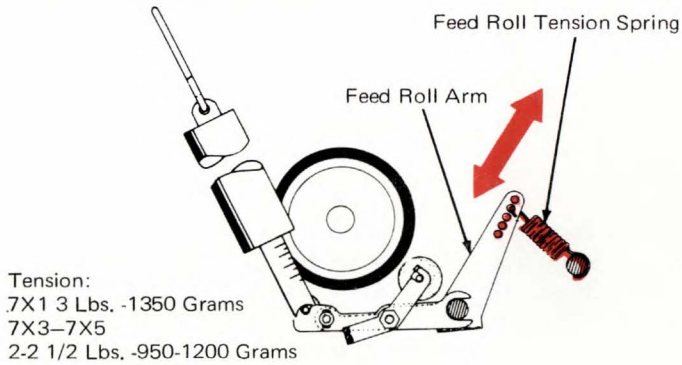
PAPER FEED & INDEX ADJUSTMENTS

NOTE: The platen position must be correct before any paper feed adjustments are attempted.

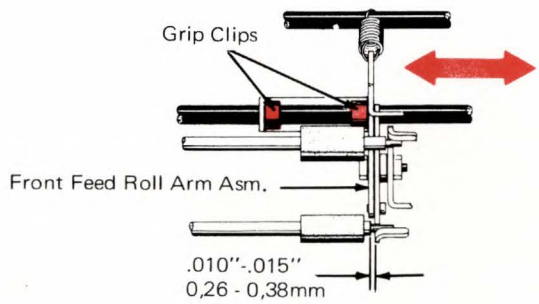
1. *Paper Feed Support* – With the feed roll tension springs disconnected the center support bracket should be positioned so that the forward lug just touches the underside of the feed roll actuating shaft while the rear lug just touches the top of the carriage tie rod. The center support bracket should not bow the copy control shaft.



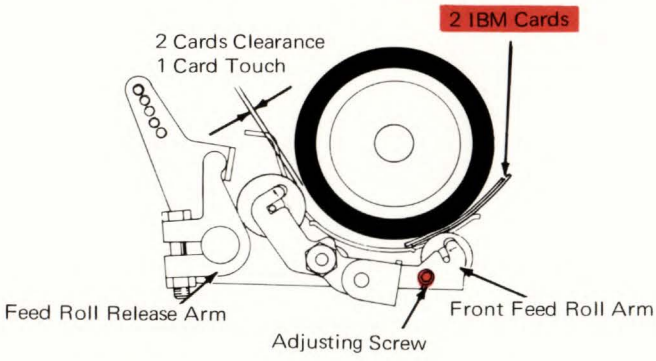
2. *Feed Roll Tension* – Place the feed roll tension springs in the hole of the feed roll arms that will provide proper tension measured at the front feed roll pivot points. The 7X1 machines should be adjusted for 3 pounds tension and the 7X3, 7X5 machines should be adjusted for 2-2 1/2 pounds tension.



3. *Feed Roll Side Play* – The right hand front feed roll arm assembly on the 7X1 and the left and right hand front feed roll arm assemblies on the 7X3 – 7X5 should be adjusted by moving the grip clips on the feed roll actuating shaft to permit the feed rollers to have a slight amount of side play without touching the openings in the deflectors.



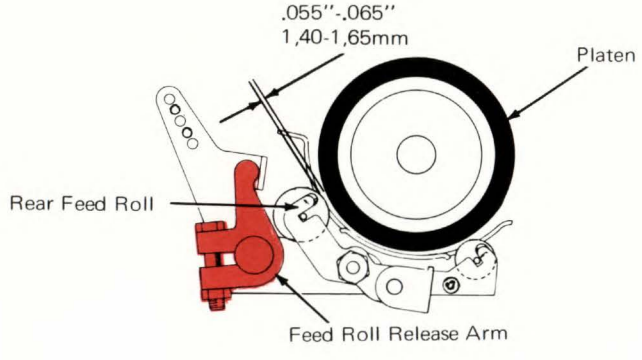
4. *Feed Roll Adjustment* – Adjust the front feed roll arms vertically to obtain a slight clearance between the rear feed rollers and the platen when two tab cards are between the front feed rollers and the platen. With one tab card between the front feed rollers and the platen, the rear feed rollers should have a slight drag on the platen.



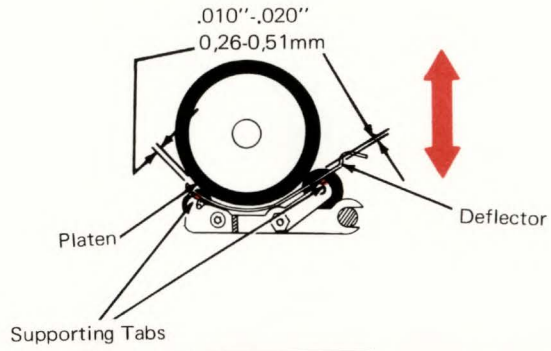
An easy method to make this adjustment is as follows:
Remove the paper deflector and insert three tab cards between the rear feed rollers and the platen. Loosen the adjusting screw. While pressing the front feed roll arm toward the platen, tighten the adjusting screw. Do the same for the opposite end. Then check for the above adjustment. The feed roll release arms must not restrict the feed roll arms.

5. *Paper Release* – Adjust the feed roll release arms front to rear to obtain .055"-.065" clearance between the rear feed rollers and the platen when the feed rollers are released.

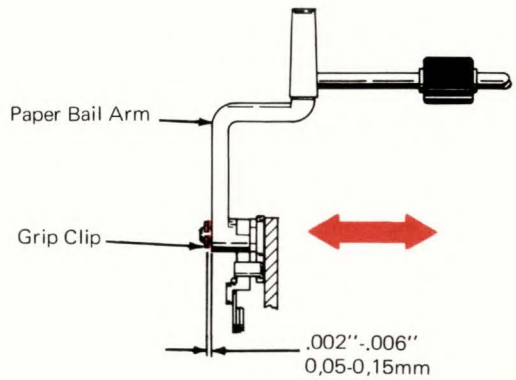
The excessive clearance can cause interference between the front feed roll and the carrier, whereas insufficient clearance will not permit straightening of thick paper packs.



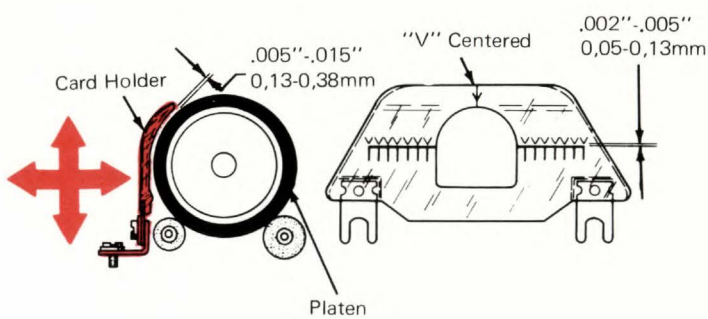
6. *Deflector* – Form the deflector supporting tabs on the front and rear feed roll arms to obtain a clearance of .010"-.020" between the deflector and the platen. Three tab cards inserted between the platen and the deflector, at the front and rear, should provide a slight drag. No drag should be felt when one tab card is inserted.



7. *Paper Bail* – Adjust the grip clip on the paper bail pivot shaft to obtain .002"-.006" end play of the paper bail arm.

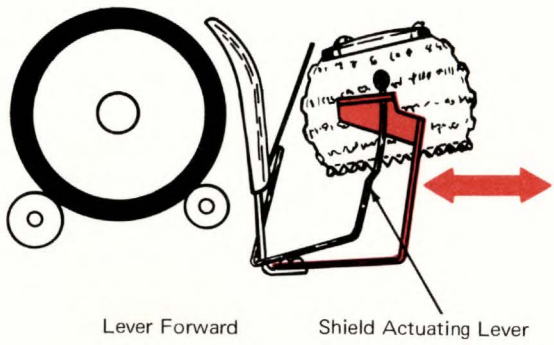


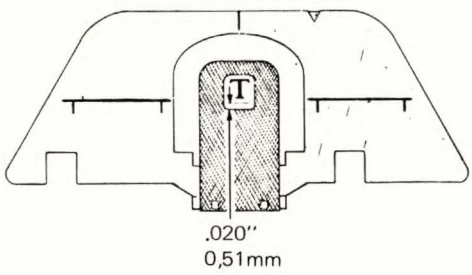
8. *Cardholder* – Adjust the cardholder brackets front to rear to obtain .005"-.015" clearance with the platen. The vertical adjustment should be such that the horizontal gradual is parallel and .002"-.005" below the feet of the typed characters when viewed from the operator's position. Adjust the cardholder left to right so the point of the letter "v" will align with the vertical graduals on the cardholder.



9. *Removable Print Shield* – Adjust the shield actuating lever to satisfy the following conditions: (a) So the shield is against the platen when the lever is in the rear, latched position. (b) The print shield should rest against the element with the shield actuating lever in the forward or typing position. Crease the shield at the bottom if necessary to obtain this condition. (c) When the load lever of the film ribbon mechanism is activated, the shield will automatically be positioned to the rear. The ribbon must be installed between the shield and the typehead.

When the cardholder is adjusted for proper registration, the shield will be in the correct position. As an adjustment check, type an upper case "T", backspace and type an underscore. The "T" should be in the center and the underscore approximately .020" from the bottom of the hole.



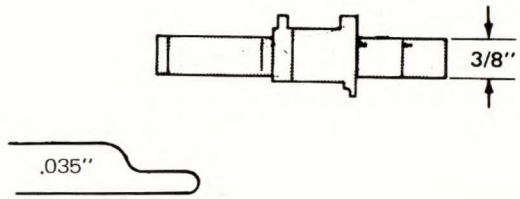


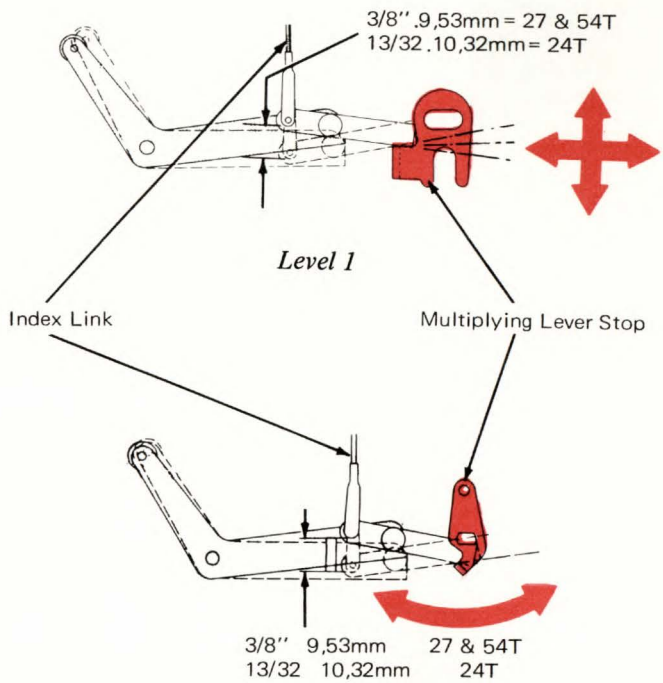
NOTE: All operational control adjustments must be correct before attempting to make the following index adjustments.

10. *Multiplying Lever Stop* – On machines equipped with either a 27 or 54 tooth ratchet, adjust the multiplying lever stop front to rear to produce 3/8" motion to the index link when the carrier return index cam is operated to its high point (platen removed).

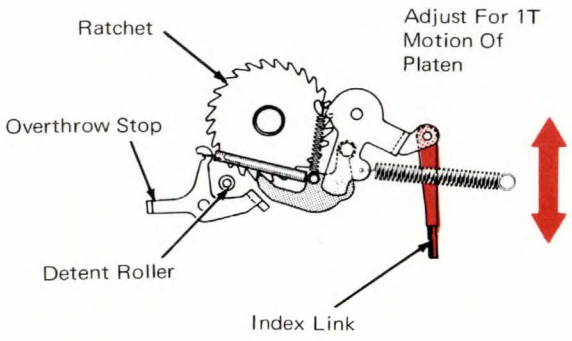
On machines equipped with other ratchets, adjust the multiplying lever stop front to rear to produce approximately 13/32" motion to the index link when the carrier return index cam is operated to its high point (platen removed).

NOTE: This adjustment may be measured with the hooverometer and a feeler gage. The handle of the hooverometer is 3/8" wide. The 13/32" adjustment can be gaged by the width of the hooverometer handle plus a .035" feeler gage.

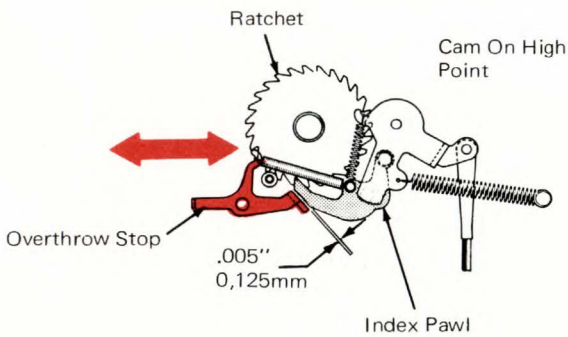




11. *Index Link* – As a preliminary step, loosen the platen overthrow stop and move it to the front of the machine. With the platen installed and the feed rolls engaged, hold the detent roller disengaged from the platen ratchet. Manually cycle an index operation. At the end of the cycle, allow the detent roller to re-enter the platen ratchet. If the index link is properly adjusted, the detent roller will seat between the two ratchet teeth without causing any rotational movement to the platen. Adjust the index link clevis to obtain this condition.

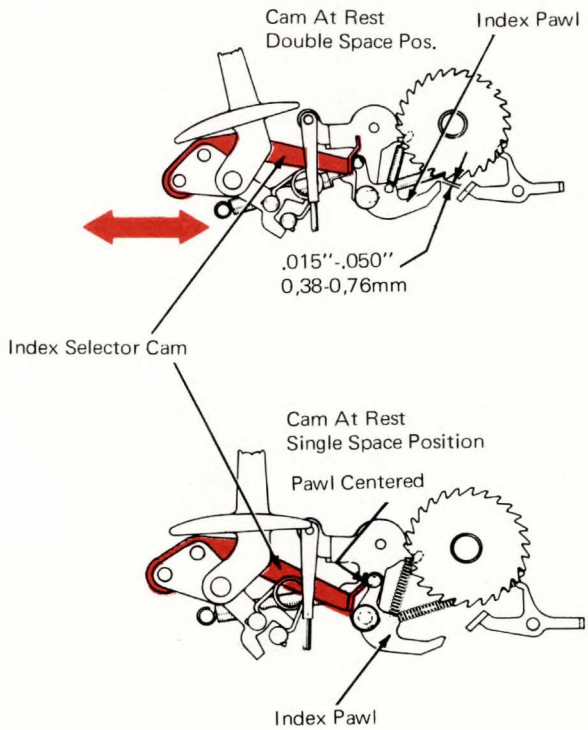


12. *Platen Overthrow Stops, – Adjust the platen over-*throw stop front to rear to obtain a clearance of .005" between the index pawl and the platen overthrow stop with the index cam rotated to its high point.

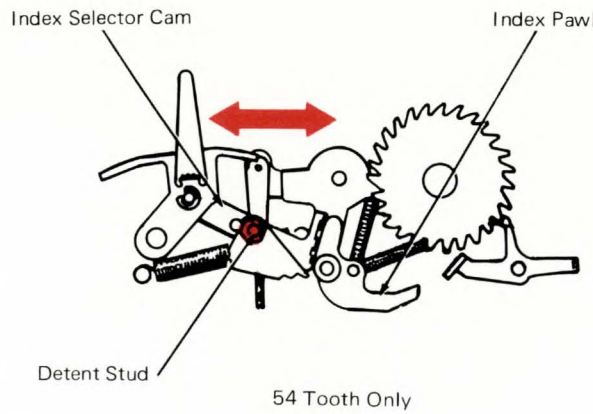


13. *Index Selector Cam* – With the index cam at rest and the index lever in the double space position, adjust the selector cam front to rear so the index pawl clears the platen ratchet by .015"-.050". With the index lever in the single space position, adjust the selector cam vertically so the index pawl is centered on the cam surface.

These adjustments must be considered together and refined until both are correct.

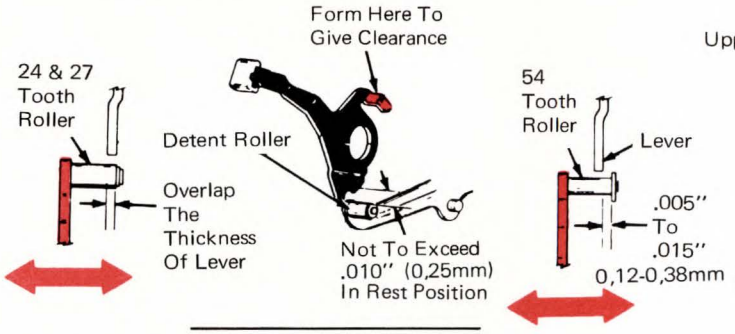


On machines equipped with a 54 tooth ratchet, adjust the index selector detent stud so the index pawl will reliably enter the correct ratchet tooth to produce a feed of 2, 3 or 4 ratchet teeth when the index lever is placed in first, second or third index position.

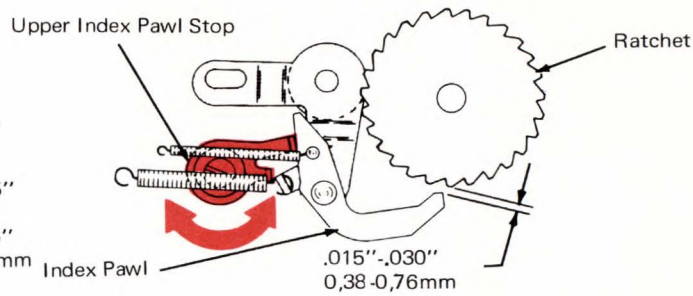


54 Tooth Only

14. *Line Position Reset Lever* – Form the right hand extension of the line position reset lever to obtain .001"-.010" clearance between the detent roller and the lever with the lever at rest. Form the detent arm so the lever overlaps the detent roller by the thickness of the lever. Machines equipped with a 54 tooth detent arm should have .005"-.015" between the lever and the c-clip.



16. *Upper Index Pawl Stop* – With the index cam latched at rest, adjust the upper index pawl stop to obtain .015"-.030" clearance between the index pawl and the platen ratchet.

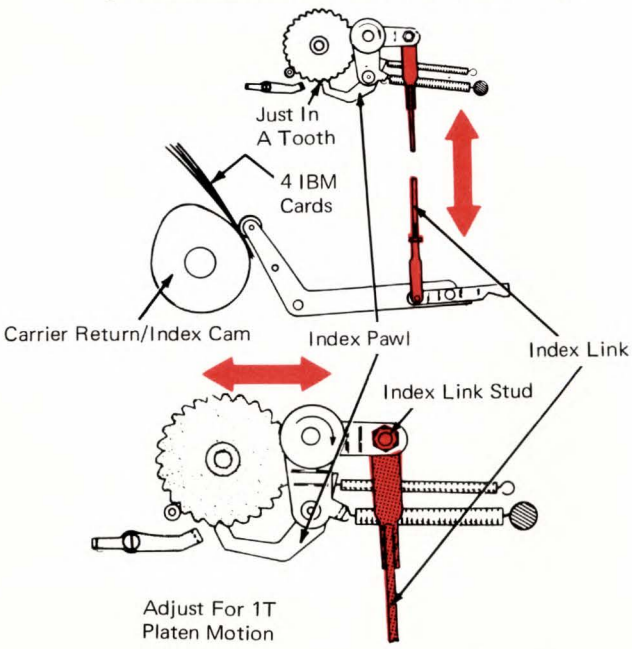


The following adjustments are for early level machines only.

15. *Index Link and Index Stud* – As a preliminary setting, position the index link stud in the middle of the slot in the pawl carrier. Subsequent adjustments may require that the position be altered slightly. With the index selection lever in the single line space position and the carrier return index cam latched at rest, insert four tab cards between the carrier return cam and the cam follower. Adjust the index link so the index pawl is bottomed in the ratchet against the tooth.

With the carrier return index cam on the high point, adjust the index stud front to rear to obtain one full tooth of motion from the index pawl after it starts to drive the platen. The upper index pawl stop must allow the index pawl to bottom in the ratchet.

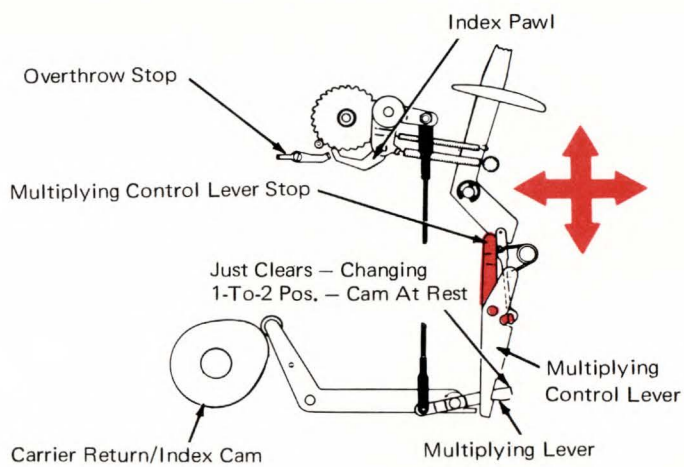
NOTE Adjustment of the index link and index link stud must be considered together. Make these adjustments alternately until both are correct.



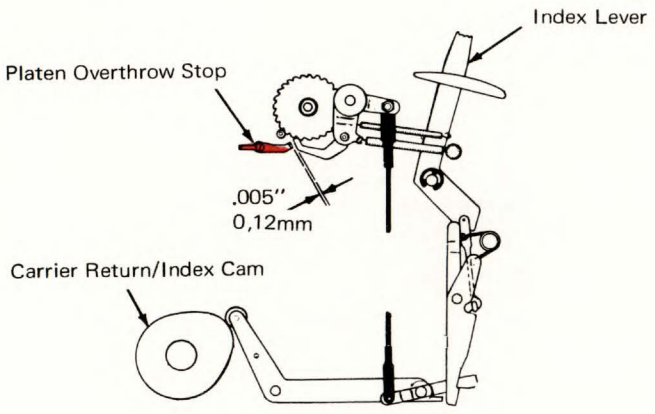
17. *Multiplying Control Lever* – Position the multiplying control lever stop front to rear so the elongated hole is centered. This is a preliminary adjustment and may need to be changed slightly.

Adjust the multiplying control lever vertically to just clear the bottom edge of the multiplying lever with the carrier return index cam at rest. Keep the high point of the eccentric toward the front of the machine.

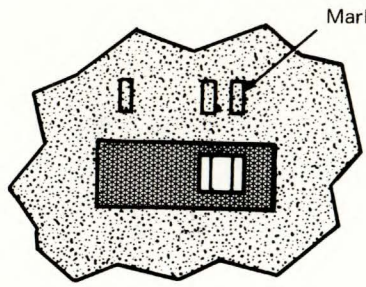
Adjust the multiplying control lever stop front to rear to obtain two full teeth of motion from the index pawl after it begins to drive the platen. Be sure that the index motion is not choked off with the platen overthrow stop.

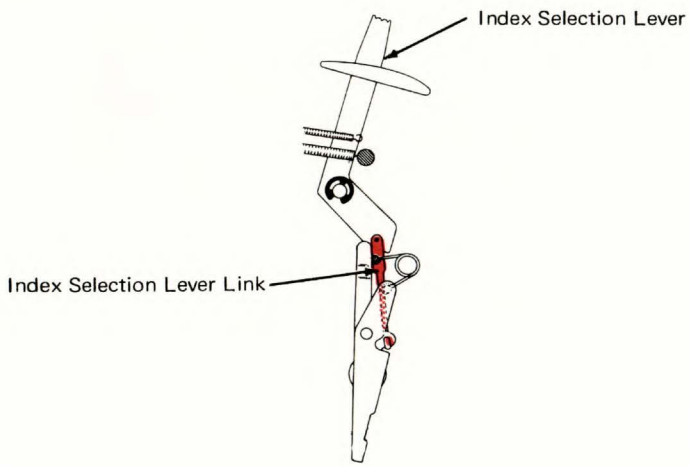


18. *Platen Overthrow Stop* – With the index selection lever in the double space position, adjust the platen overthrow stop front to rear to obtain .005" clearance between the stop and the index pawl when the carrier return index cam is on its high point.



19. *Index Selection Lever* – Adjust the index selection lever link so that the index selection lever aligns with the double mark on the case when the lever is in double space position.





The film ribbon mechanism mounts on and moves with the carrier assembly. The supply spool of ribbon mounts on a permanent supply spool on the left side of the carrier. Due to the inner-connection between the plastic core of the supply spool and the permanent supply spool, both spools rotate as a unit during a ribbon feed operation. As the ribbon comes from the supply spool, it threads around the ribbon circuit to the take-up spool. The take-up spool is a disposable, transparent spool mounted on the right side of the carrier. Once the ribbon has been used and fed to the take-up spool, both the take-up spool and the plastic core from the supply side are removed and discarded. The new ribbon to be installed comes equipped with its own take-up spool fastened to the end of a clean leader. (Fig. 1)

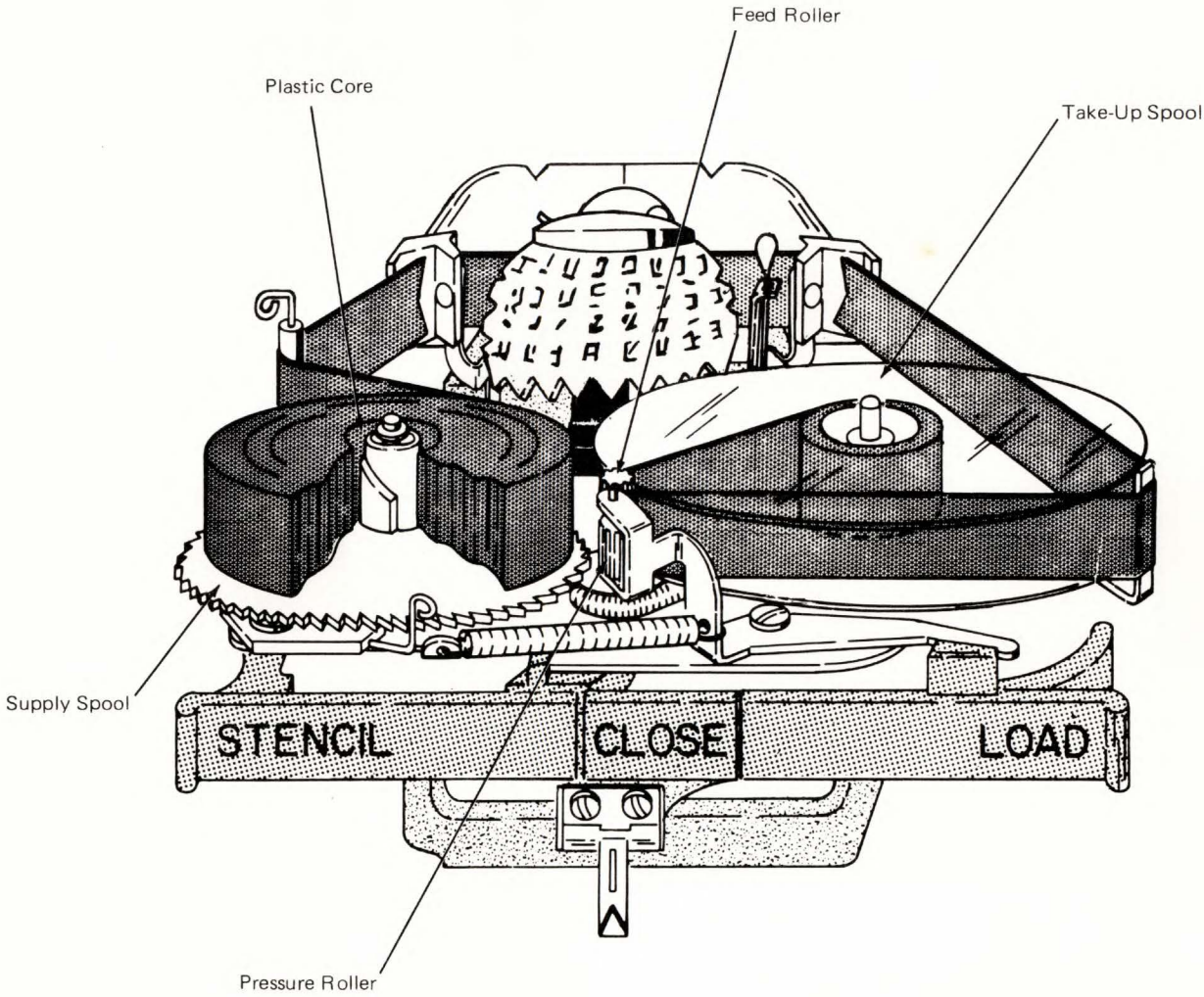


Figure 1 – Film Ribbon Mechanism

Just prior to winding up the take-up spool, the ribbon passes around a feed roller. This roller determines how fast the ribbon will feed through the machine. The ribbon feed and lift wheel is connected to the bottom of the feed roller by a left hand threaded screw. (Fig. 2)

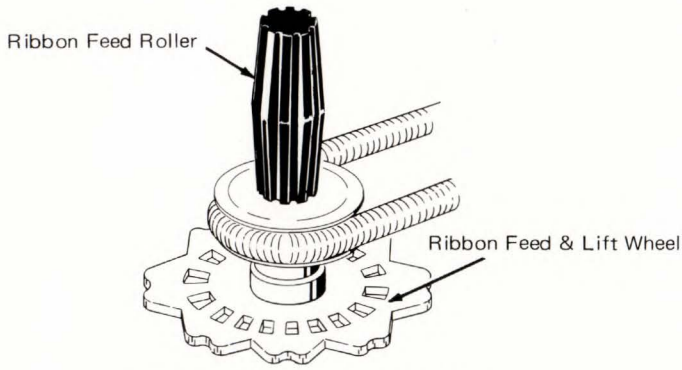


Figure 2 – Ribbon Feed Roller

The ribbon feed and lift wheel contains sixteen feed windows laid out in a circular pattern. A feed pawl operates in these windows and feeds one window each time the feed pawl is powered forward. (Fig. 3)

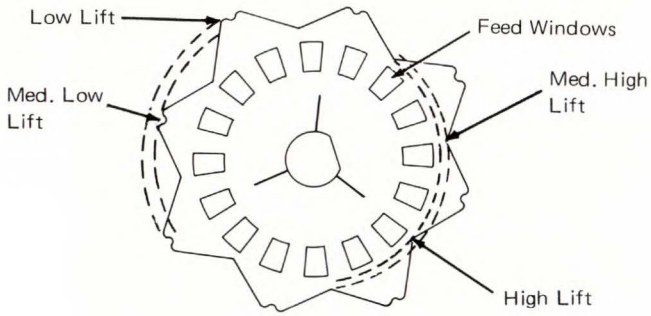


Figure 3 – Ribbon Feed & Lift Wheel

The ribbon feed cam, located on the print sleeve, supplies the motion to the feed pawl. The motion from the cam is transmitted through an adjustable stud, to the cam follower which, in turn, drives the feed pawl. The cam follower mounts on a bracket that is fastened to the front carrier casting by two hex-headed screws. An extension spring, anchored to one of these screws, loads the cam follower against the cam. The feed pawl mounts at the top of the cam follower by a shouldered rivet and is spring loaded into engagement with the ribbon feed and lift wheel. (Fig. 4)

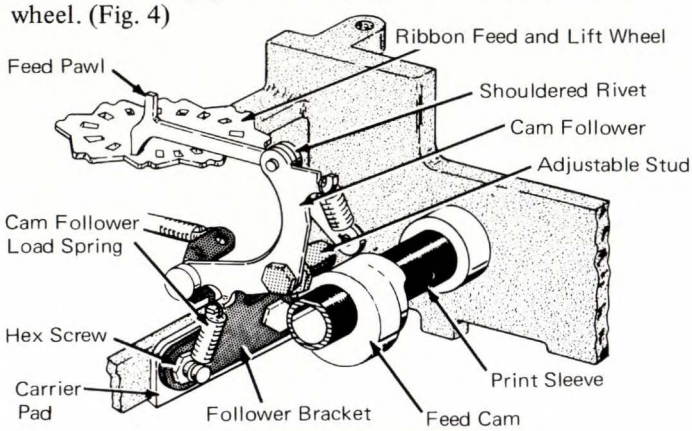


Figure 4 – Ribbon Feed Mechanism (Half Cycle Position)

Once the ribbon leaves the feed roller, the used ribbon is wound onto the transparent take-up spool. The take-up spool receives its motion from the feed mechanism by a friction type spring drive system. (Fig. 5)

A drive pulley located directly below the feed roller rotates with the feed roller during a ribbon feed operation. This drive pulley supplies the motion to the take-up pulley through a drive spring. The take-up pulley, driven by the drive spring, rotates about the take-up spool pivot stud and is held in place by a "C" clip. The shape of the belt groove in the take-up pulley is designed slightly different from that of the drive pulley. This is to permit all of the necessary slippage of the drive spring to occur at the take-up pulley and not at the drive pulley. This slippage is necessary to ensure the take-up spool will wind all of the ribbon. Two hooked lugs on the top face of the take-up pulley project into corresponding slots in the bottom of the transparent take-up spool. These lugs provide a locking connection between the take-up pulley and the disposable take-up spool.

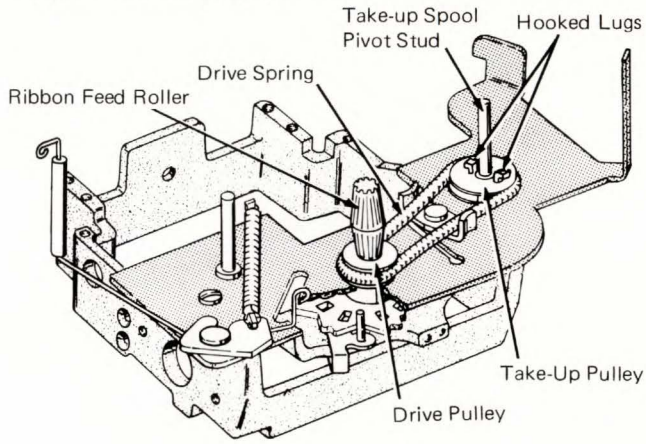


Figure 5 – Take-Up Spool Drive

To maintain a stable ribbon tracking characteristic from the supply spool to the feed and pressure rollers, the ribbon must be kept slightly taut throughout the ribbon path. Any slack in the system will affect the tracking of the ribbon. The ribbon is kept taut by means of a shock spring and detent. As the ribbon is pulled through by the feed roller, the supply spool detent, located on the front of the shock spring, releases the supply spool to allow the ribbon to feed. (Fig. 6)

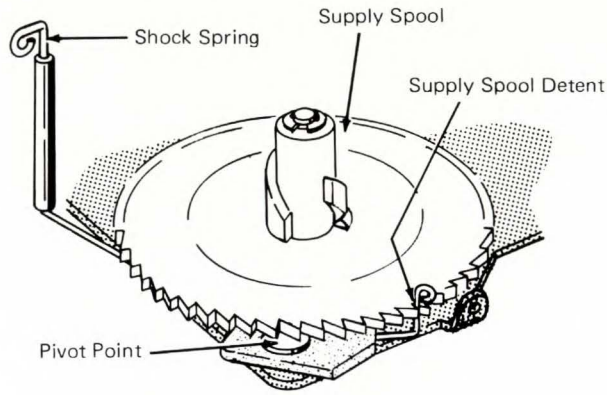


Figure 6 – Shock Spring and Detent

To obtain the desired number of characters per spool of ribbon, a 9/16" wide ribbon is used. By varying the ribbon lift position for each character, a greater number of characters can be typed on a given length of ribbon.

The ribbon lift mechanism consists of a ribbon lift cam, a cam follower, a control mechanism, and the ribbon lift guide assembly. The lift mechanism is mounted to the carrier and moves with it. The ribbon lift cam is a single lobe cam that is setscrewed to the left hand side of the print sleeve. Each time a print cycle occurs the cam makes one complete revolution. (Fig. 7)

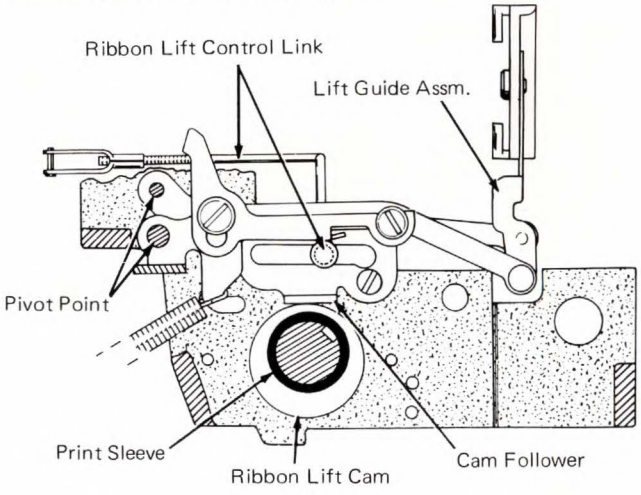


Figure 7 – Ribbon Lift Mechanism

The ribbon lift cam follower pivots on the carrier assembly above and to the rear of the cam. Each revolution of the cam raises the cam follower. The end of the ribbon lift control link fits into an elongated slot in the cam follower. The ribbon lift guide rests on the control link and pivots at the front of the carrier casting. As the cam follower is raised, the control link forces the ribbon lift guide assembly to pivot at the front and raise the rear of the assembly. A flat link from each side of the ribbon lift guide attaches to two pins at the front of the carrier to maintain the ribbon lift guide in a vertical position. (Fig. 8)

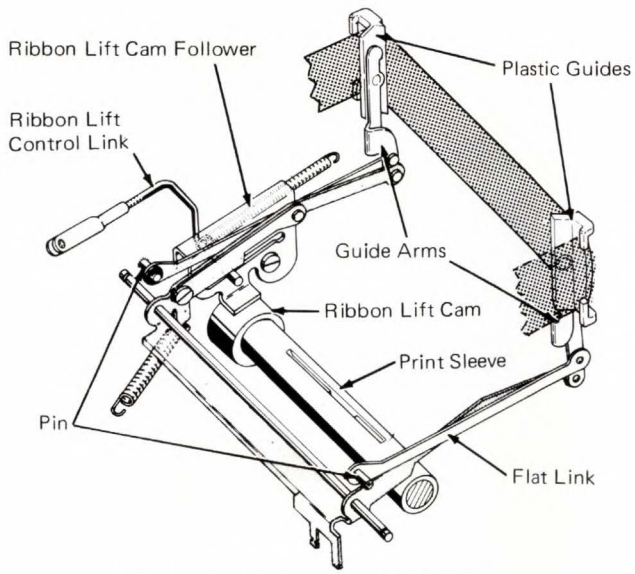


Figure 8 – Ribbon Lift Mechanism

The film ribbon lift mechanism automatically changes the lift position to one of four different lift positions during each print cycle. This is achieved by changing the location of the lift control link in the slot of the cam follower. The four lift positions obtained by moving the control link are designated by "A", "B", "C" and "D". (Fig. 9)

Positions "A" and "C" are low lift positions while "B" and "D" are high lift positions. These four lift positions occur in a definite order during a typing operation. It takes four print operations to complete a lift cycle which is from "A" to "B" to "C" to "D". On the fifth print operation, the lift cycle begins all over again with lift position "A". Changing the location of the lift control link in the slot of the cam follower produces these lift positions.

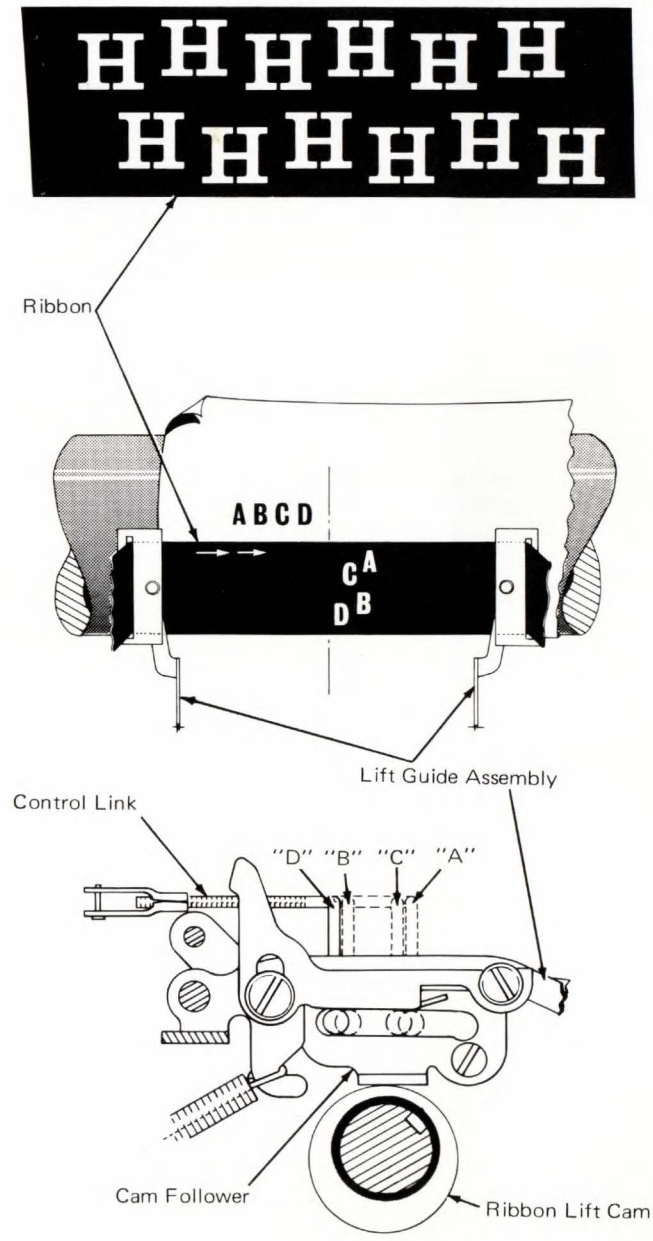


Figure 9 – Ribbon Lift Positions and Print Pattern

The different lift positions are determined by the ribbon feed and lift wheel. The camming lobes on the perimeter of the wheel govern the position of the lift control link during each ribbon feed operation. These lobes which correspond to each feed window produce the four lift positions in a consecutive order as the wheel rotates 1/16 of a turn for each ribbon feed operation.(Figs. 3 & 10)

The motion produced by the camming lobes on the ribbon feed and lift wheel is transmitted to the lift control link by the ribbon lift control lever. The lift control lever is mounted to the front of the carrier by a shouldered screw and is spring loaded against the camming lobes of the feed and lift wheel. During the early portion of a print cycle, the feed and lift wheel tends to rotate backwards with the feed pawl. This happens because the feed pawl is cammed out of the feed window as it travels toward the rear of the machine. To prevent the feed and lift wheel from rotating backwards, the ribbon lift control lever serves to detent the feed and lift wheel. This is accomplished by a detent notch cut on the high lobes of the ribbon feed and lift wheel. (Fig. 10)

The selected ribbon lift position for each print operation is always established by the ribbon feed operation from the previous print cycle. This is because the rotation of the feed and lift wheel does not occur until after the typehead has printed.

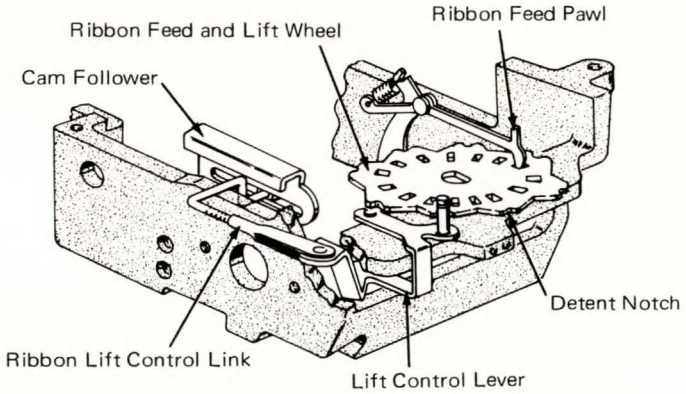


Figure 10 – Lift Control Lever

Whenever the machine is used for typing stencils, the ribbon feed and lift operation must be locked out. This is accomplished by pushing the stencil lever, located on the front of the carrier to the rear.(Fig. 11)

The lockout of the feed mechanism is achieved through a lug on the stencil lever. In the stencil position, the lug pivots to the right into the path of the upright lug of the feed pawl. Ribbon feed is interrupted because the feed pawl is not allowed to move to the rear and drop into the next feed window.

Lockout of the lift operation is achieved by a camming surface on the left end of the stencil lever. As the lever is pushed into the stencil position, the lift control lever is cammed away from the feed and lift wheel. This causes the control link to move to the rear of the slot in the cam follower where no lift motion will be produced to the ribbon lift guide assembly.

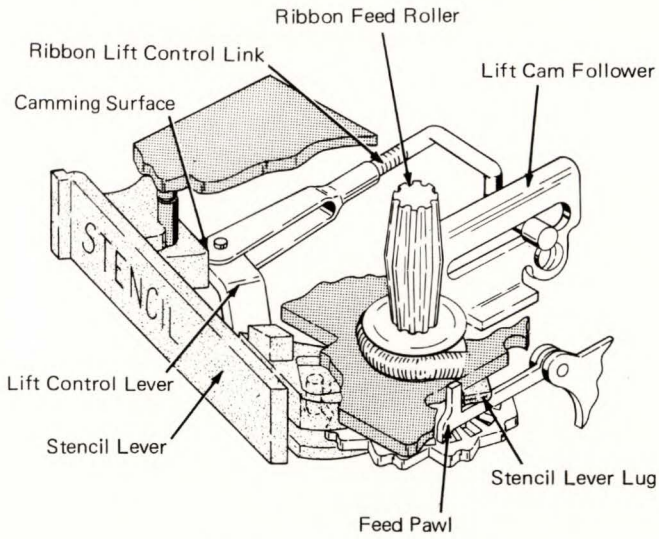


Figure 11 – Stencil Lockout

When the operator desires to change the ribbon, she begins by pushing the load lever to the rear into its load position. This causes the ribbon lift guide assembly to rise above the element so the ribbon may be easily threaded through the guides. Latching the load lever in its load position caused the lower extension of the load lever to contact an extension on the lift guide assembly and cam it upward. At the same time, an extension on the pressure roller lever is contacted by the upper portion of the load lever and pivots the pressure roller away from the feed roller. The operator may now install a ribbon with no obstructions. (Fig. 12)

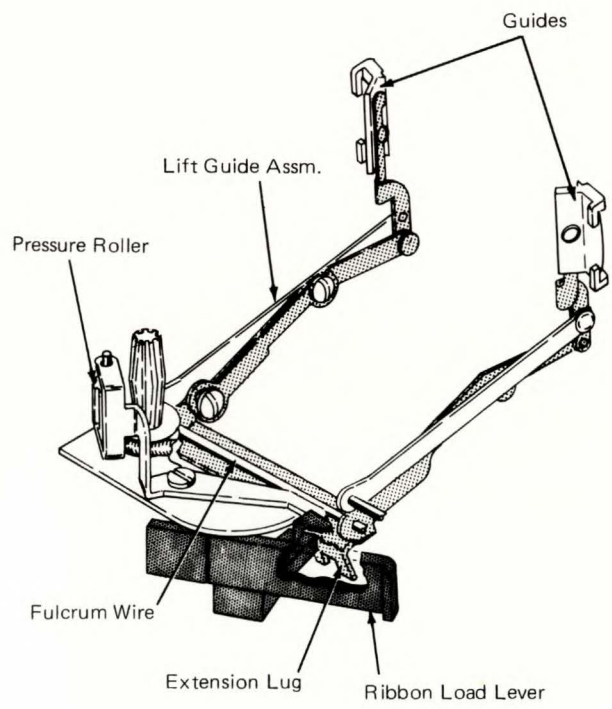


Figure 12 – Ribbon Load Position

The early level film ribbon mechanism differs slightly from the mechanism just described. A supply drag lever is in contact with the ribbon on the supply spool. (Fig. 13)

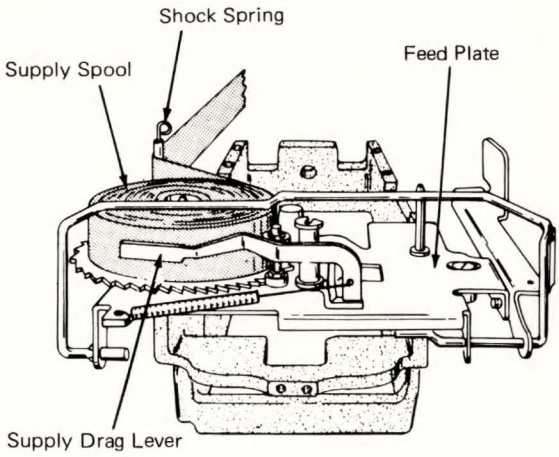


Figure 13 – Supply Drag Lever

A separate supply spool brake is used to stabilize the ribbon during the vibrations caused by repeat spacebar, backspace or underscore. During a feed operation, the supply spool brake is mechanically disengaged by the ribbon lift mechanism. The upper extension of the lift guide plate contacts the brake actuating lever when the lift guide is in the raised position. As the brake actuating lever pivots about its pivot point, it cams the supply spool brake out of engagement with the supply spool. (Fig. 14)

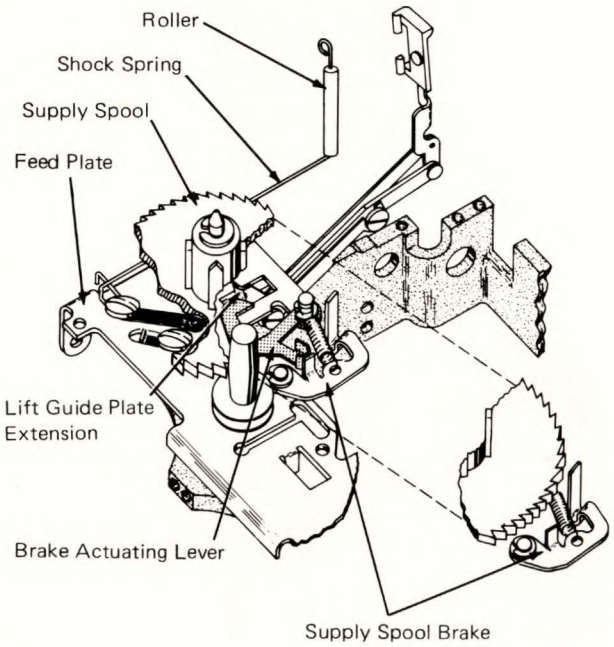


Figure 14 – Ribbon Shock Spring and Brake Actuating Lever

To prevent the ribbon feed and lift wheel from rotating backward during a feed operation, a detent spring rides in the feed windows of the ribbon feed and lift wheel. (Fig. 15)

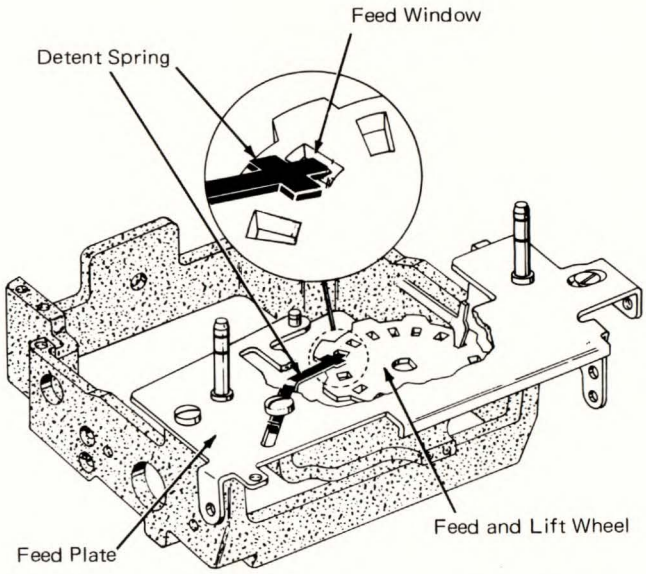


Figure 15 – Feed & Lift Wheel Detent Spring

In the stencil position, a shield is rotated beneath the feed pawl to prevent the feed pawl from operating in the feed windows. Lockout of the lift mechanism is achieved in the same manner as the present mechanism. However, the parts design is slightly different. (Fig. 16)

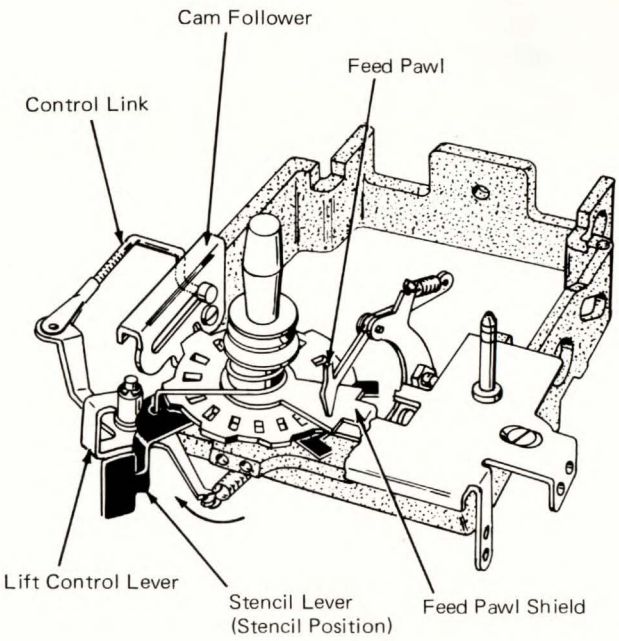


Figure 16 – Stencil Lockout

The ribbon load operation is initiated by a ribbon load bail. A link is connected between the ribbon load bail and the load lever. The load lever raises the lift guide assembly in the same manner as the current load lever. (Fig. 17)

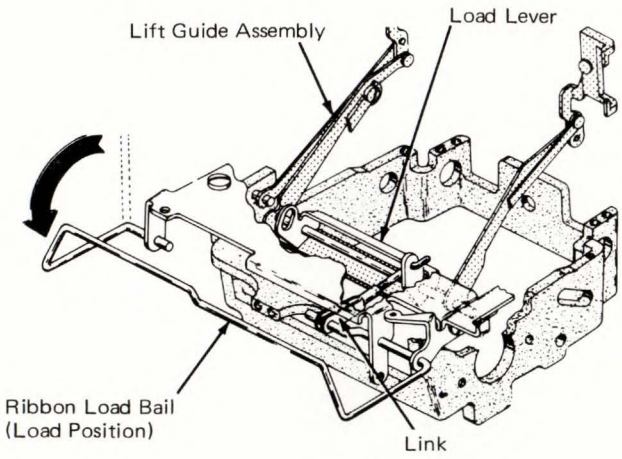


Figure 17 – Ribbon Load Operation

An adjustable pressure roller release arm is attached to the load lever to release the pressure roller in the load position. The pressure roller release arm pushes against the pressure roller lever. As the pressure roller lever pivots away from the feed roller, it also cams the supply drag lever away from the supply spool. Thus, all obstructions are removed to permit the operator to install a new ribbon. (Fig. 18)

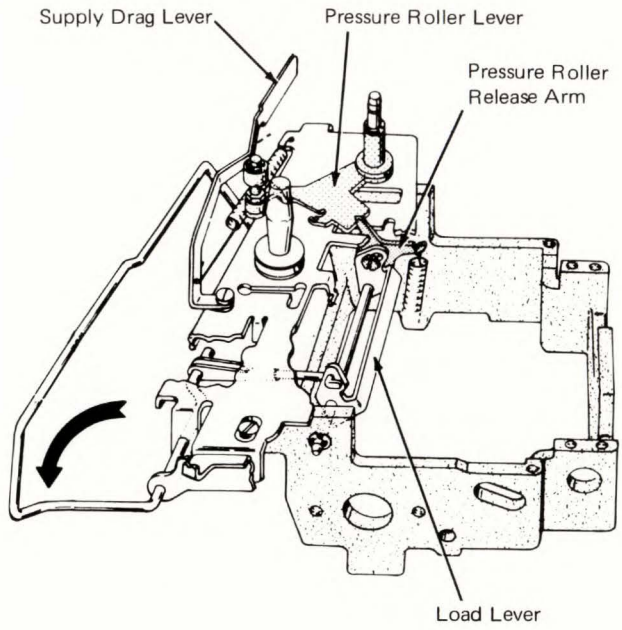
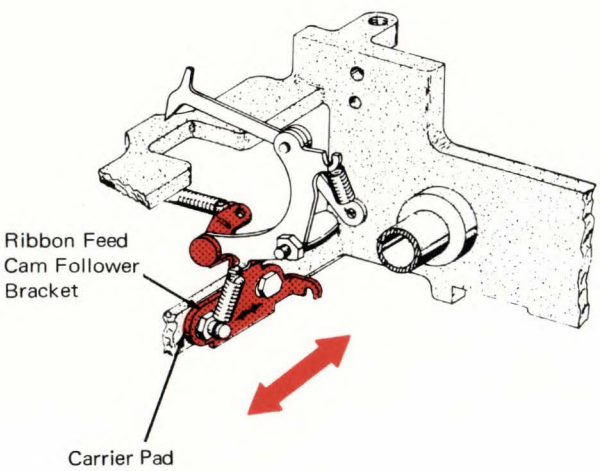


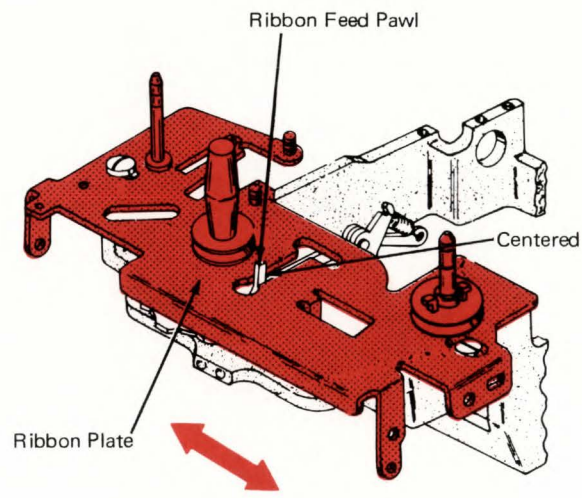
Figure 18 – Pressure Roller Release

FILM RIBBON ADJUSTMENTS

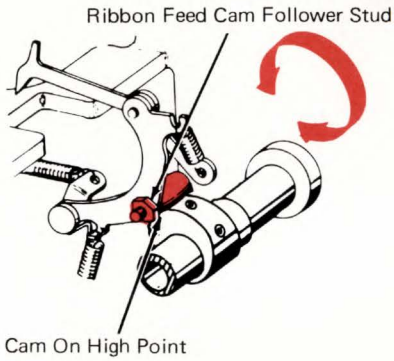
1. *Ribbon Feed Cam Follower Bracket* – With the nylon carrier pad against the carrier casting, the ribbon feed cam follower bracket should be centered left to right in its mounting hole. Keep the bottom of the bracket parallel to the carrier pad.

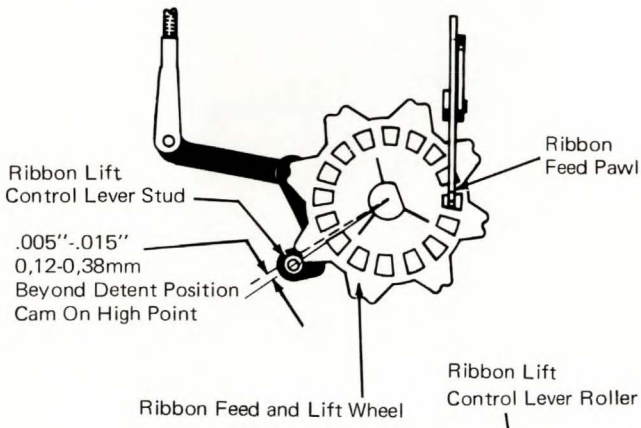


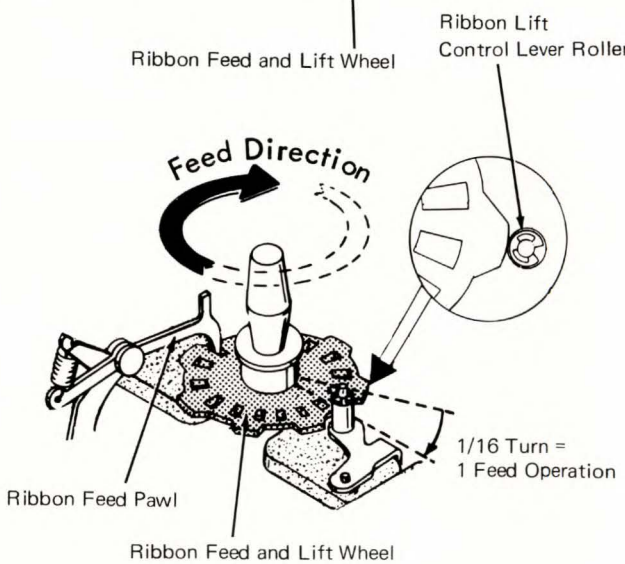
2. *Ribbon Plate* – Adjust the ribbon plate left to right so the ribbon feed pawl is centered in the operating slot. The ribbon feed pawl must move freely front to rear in its slot.



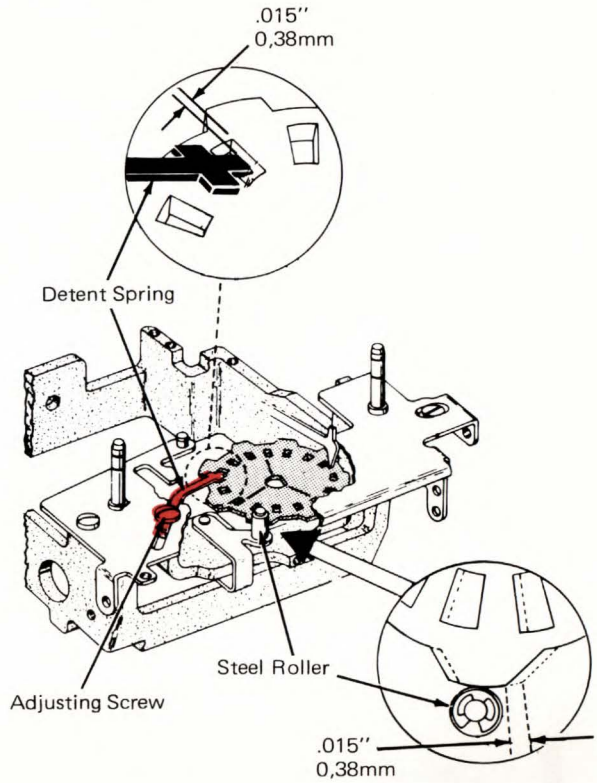
3. *Ribbon Feed Cam Follower Stud* – Hand cycle the machine and observe the lift control lever stud as it moves from the low point to the high point on the ribbon feed and lift wheel. Adjust the ribbon feed cam follower eccentric stud so the ribbon lift control lever stud overthrows the detent notch in the ribbon feed and lift wheel by .005"-.015". Machines not equipped with the detented positions on the ribbon feed and lift wheel should be adjusted so the lift control lever roller is centered on the high dwell of the ribbon feed and lift wheel.



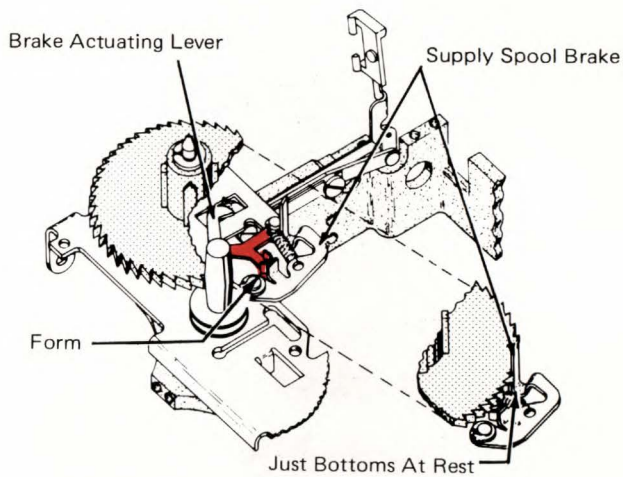




4. *Ribbon Feed and Lift Wheel Detent Spring (Level 1 Only)* – Hand cycle the machine and observe the ribbon feed and lift wheel detent spring as the ribbon lift control lever roller moves from the low point to the high point on the ribbon feed and lift wheel. The ribbon feed and lift wheel should travel .015" after the detent spring drops into a feed window.



5. *Brake Actuating Lever (Level 1 Machines Only)* Form the lug on the brake actuating lever so the supply spool brake is allowed to just bottom in the ratchet teeth of the supply spool when the machine is at rest.



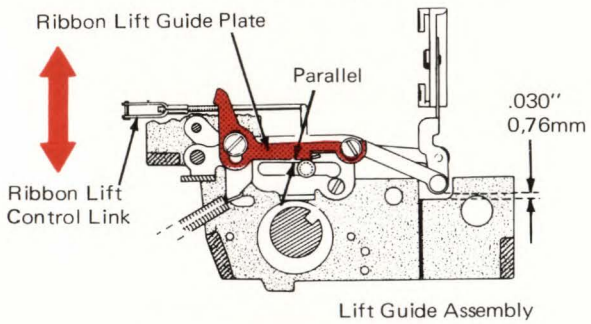
6. *Ribbon Lift Guide Plate* – With the ribbon lift cam follower on the low point of the ribbon lift cam, position the lift guide plate on the arm of the lift guide assembly to satisfy the following conditions:

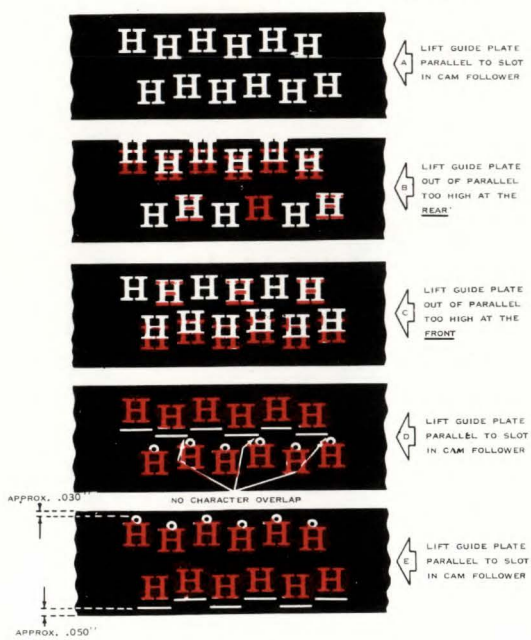
   a. Position the lift guide plate vertically so the rear of the lift guide assembly rests .030" above the carrier casting when the stencil lever is not in the stencil position.

      The verticalness of the lift guide plate may be checked by observing the lift guide assembly while manually pushing the control link all the way to the rear into its stencil position. The guide assembly should drop .030" at the rear if the adjustment is correct.

   b. Position the lift guide plate horizontally so its bottom surface is parallel to the slot in the cam follower.

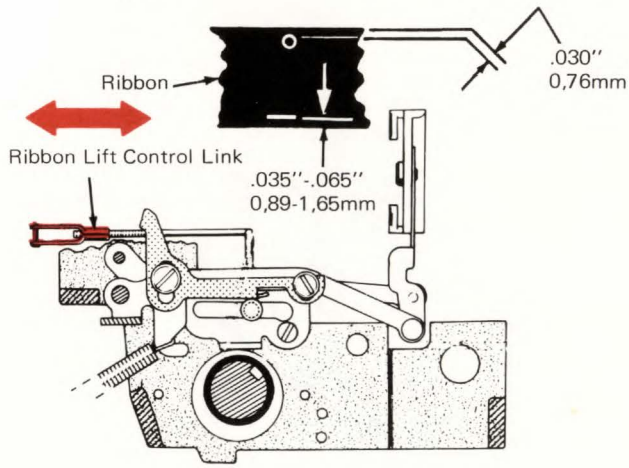
      The parallel adjustment of the lift guide plate may be checked in the following manner. With the cam follower resting on the low point of the lift cam, disconnect the control link and manually slide the link front to rear through the four lift positions. If the plate is parallel, no movement will be produced to the ribbon lift guide assembly while sliding the link back and forth. Do not slide the link into the stencil position while making this check.




A
LIFT GUIDE PLATE PARALLEL TO SLOT IN CAM FOLLOWER
B
LIFT GUIDE PLATE OUT OF PARALLEL TOO HIGH AT THE REAR
C
LIFT GUIDE PLATE OUT OF PARALLEL TOO HIGH AT THE FRONT
D
LIFT GUIDE PLATE PARALLEL TO SLOT IN CAM FOLLOWER
NO CHARACTER OVERLAP
APPROX. .030"
E
LIFT GUIDE PLATE PARALLEL TO SLOT IN CAM FOLLOWER
APPROX. .050"

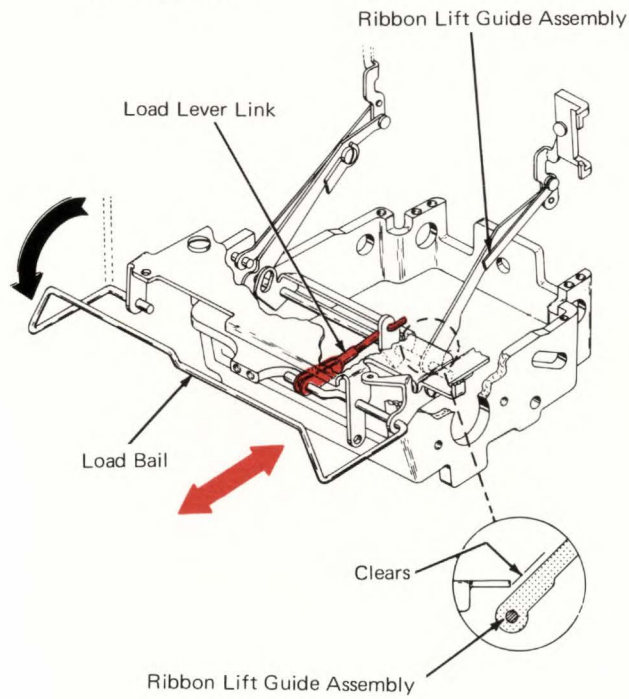
7. *Lift Control Link* – Adjust the clevis on the ribbon lift control link so the lowest underscore prints .035"-.065" from the bottom edge of the ribbon. The degree character should be at least .030" from the top of the ribbon.

   NOTE: The adjustment of the ribbon lift control link positions the lift pattern on the ribbon and does not have any affect on the distance or spread between each of the four lift positions in the pattern.



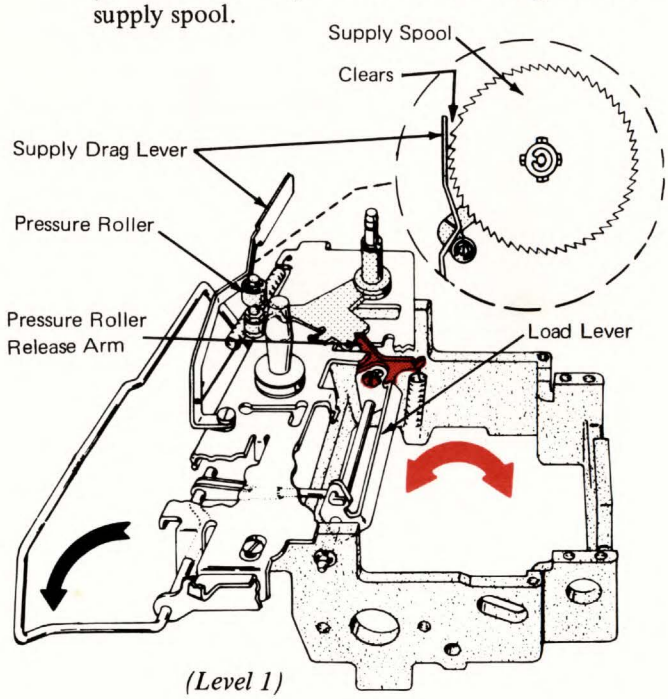
Adjustments 8 through 14 are for level 1 mechanisms only.

8. *Load Lever Link* – Adjust the load lever link to raise the ribbon lift guide assembly as high as possible without binding off on either the ribbon feed plate or the take-up spool when the load bail is in the load position.



(Level 1)

9. *Pressure Roller Release Arm* – Adjust the pressure roller release arm beneath its binding screw, located on the left end of the load lever, so the supply drag lever will be pushed forward by the pressure roller to just clear the front edge of the supply spool.

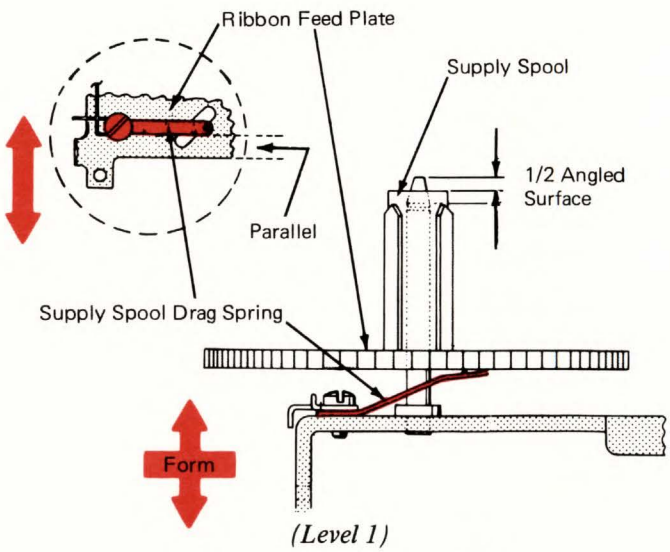


(Level 1)

10. *Supply Spool Drag Spring* – Adjust the supply spool drag spring to satisfy the following conditions:

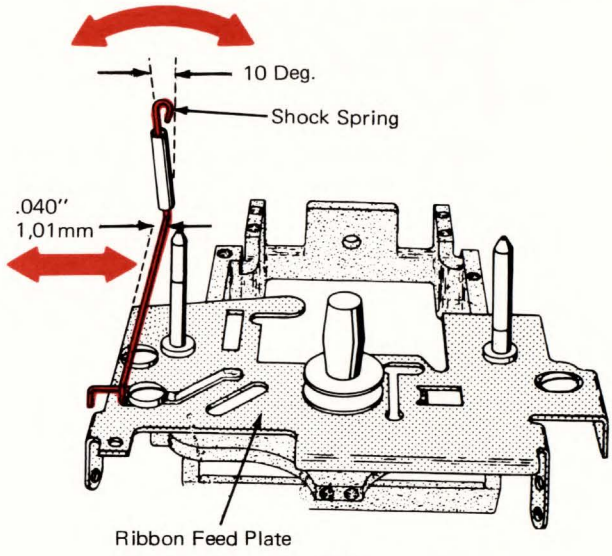
a. Position the drag spring parallel to the front edge of the ribbon feed plate.

b. With the "C" clip removed, the drag spring should raise the supply spool so half of the angled surface on top of the pivot stud is protruding above the top face of the spool. Form the drag spring up or down to obtain this condition.



(Level 1)

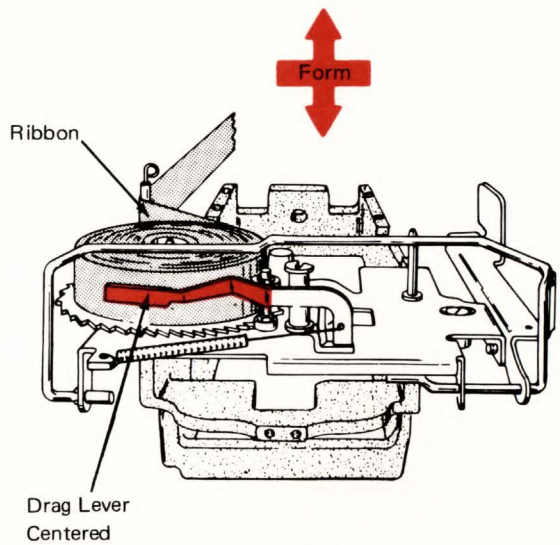
11. *Shock Spring* – Position the shock spring so it is approximately .040" to the right and parallel to the edge of the ribbon feed plate. The shock spring should be formed to make the roller on the shock spring lean 10 deg. to the left.



(Level 1)

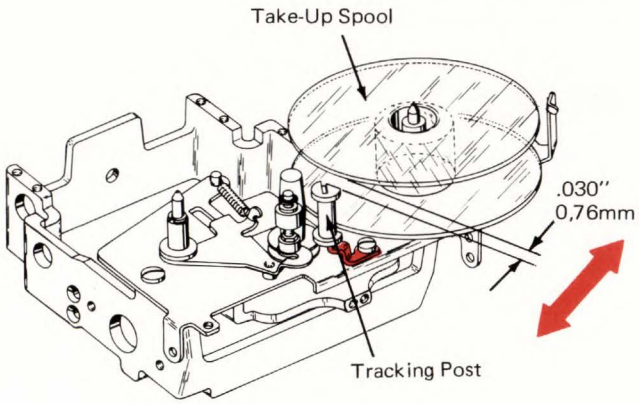
12. *Drag Lever* – The supply spool drag lever must contact the outer wrap of the ribbon on the supply spool at the center or slightly above. Form the lever to obtain this condition. Do not form it front to rear.

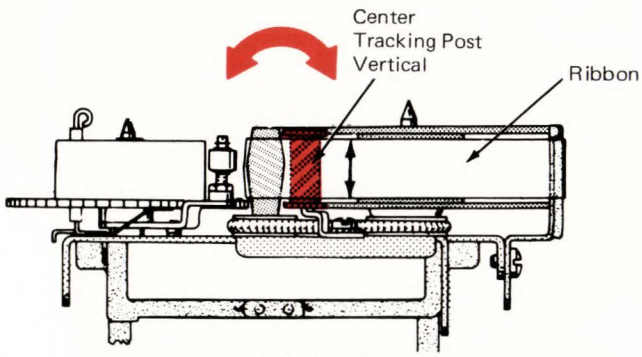
NOTE: After forming the lever make sure that it does not bind on its pivot screw. If the supply spool drag lever contacts the ribbon below center, the outer wraps of the ribbon spool will tend to creep up which may cause ribbon spillage.



(Level 1)

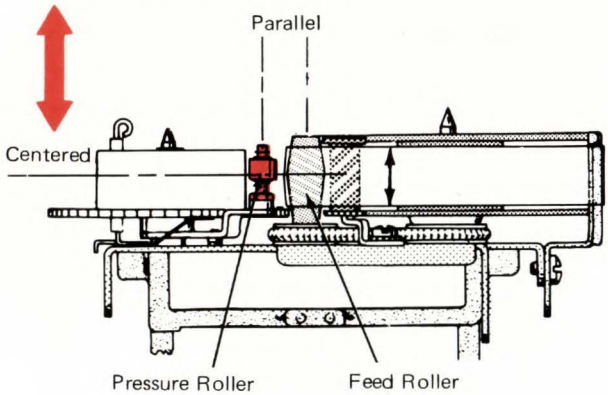
13. *Tracking Post* – Position the tracking post under its mounting screw so it clears the flanges of the transparent take-up spool by .030". Form the tracking post at the bottom so the tracking post is vertical to the feed plate. If the tracking post is vertical, the ribbon will be centered as it passes between the two flanges of the transparent take-up spool. It should also track on the center of the feed roller and evenly between the two flanges of the tracking post without touching either flange.





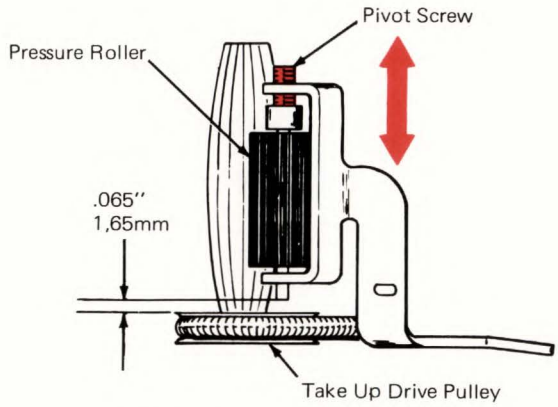
(Level 1)

14. *Pressure Roller* – Adjust the pressure roller vertically on its mounting stud so it engages the center crown on the feed roller. The pressure roller mounting stud should be parallel to the previously aligned tracking post.

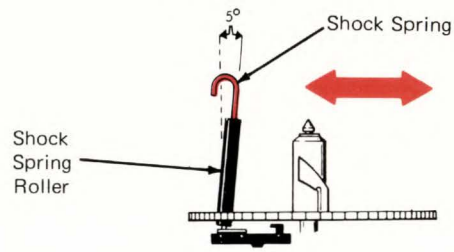


(Level 1)

15. *Pressure Roller (Level 2 Only)* – Machines with the adjustable geared pressure roller should be adjusted so the lower end of the pivot screw clears the take-up drive pulley by .065".

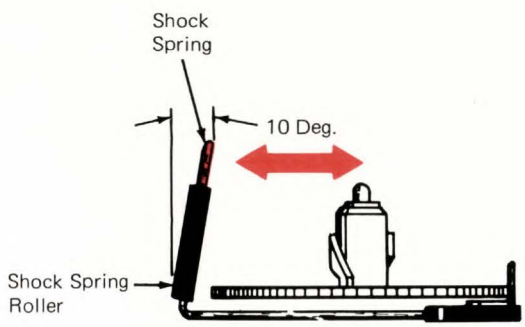


16. *Shock Spring (Level 2 Only)* – Form the shock spring to satisfy the following conditions:
   a. When viewed from the front of the machine, the shock spring should be formed to make the roller on the shock spring lean 5 deg. to the right.



Front View

   b. When viewed from the side, the shock spring should be formed so the roller leans to the front 10 deg.



Side View

The fabric ribbon mechanism can be divided into two separate distinct mechanisms. They are the ribbon lift mechanism and the ribbon feed mechanism. The ribbon lift raises the ribbon to the printing position before the typehead prints and then restores the ribbon to allow a visible writing line. The ribbon feed moves the ribbon laterally past the printing point to provide an unused portion for the next typing operation. Included in the ribbon feed mechanism is the ribbon reversing mechanism which changes the feeding direction when either end of the ribbon is reached.

The ribbon is a 9/16" fabric ribbon enclosed in a disposable cartridge unit for clean handling. The cartridge unit contains two spools on which the ribbon is wound. The ribbon is constantly fed from one spool to the other and back again. Once the ink supply has been depleted, the cartridge is simply snapped off, discarded and a new cartridge is installed. (Fig. 1)

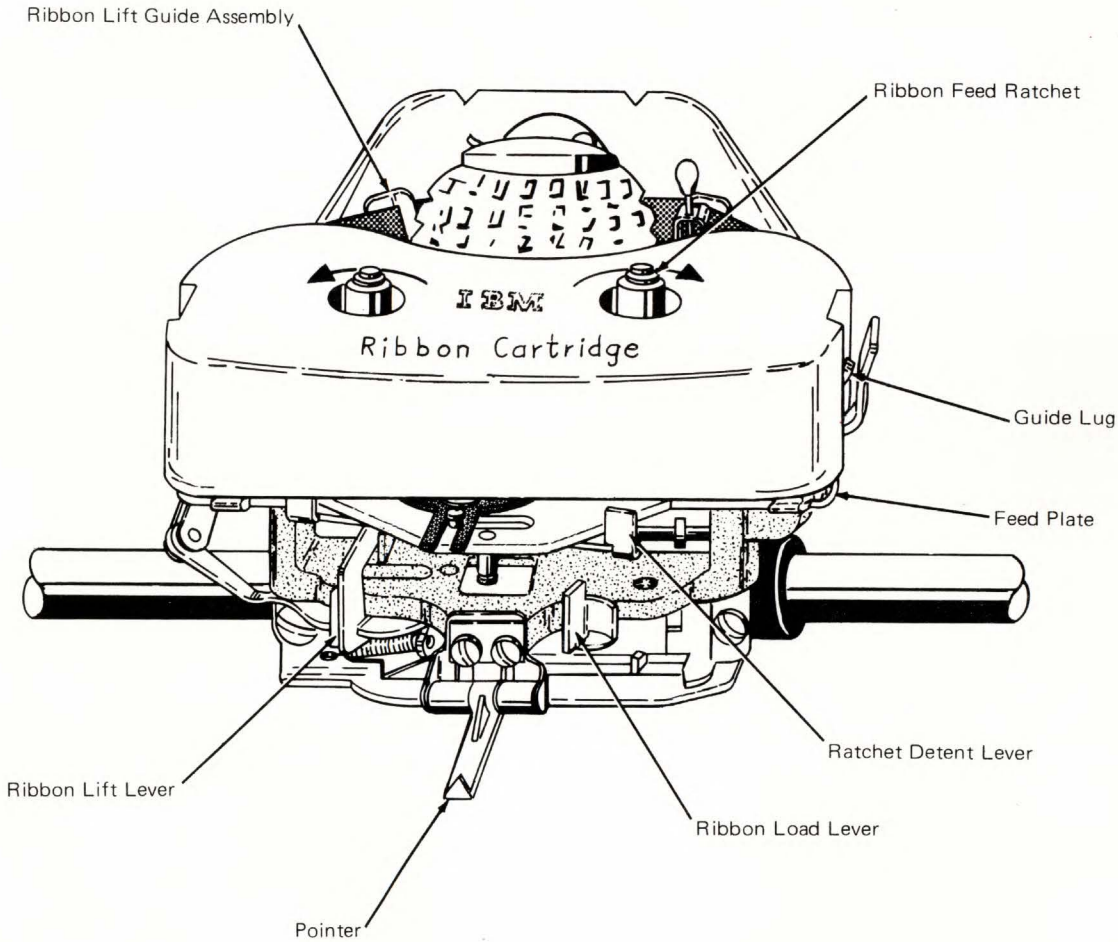


Figure 1 – Carrier Assembly (Fabric Ribbon Installed)

Located to the right of the pointer on the carrier assembly is the ribbon load lever. When this lever is pushed to the right, it forces the ribbon lift guide into an extreme lift position for convenience of changing the ribbon. This load lever is detented to hold the ribbon lift in the high lift position. The cartridge is then removed from the ribbon feed plate and the ribbon can be easily removed from the guide without touching the ribbon.

A new ribbon can be installed by reversing the above procedure. Tapered lugs on the sides of the ribbon feed ratchet cores automatically guide the ribbon spools into the correct position. Guide lugs at each side of the feed plate maintain the lateral position of the cartridge. Retainer springs attached to the guide lugs hold the cartridge down to prevent vibration. After the ribbon is installed, the load lever is moved back to the left to allow the ribbon to restore to its normal positon for a typing operation.(Fig. 2)

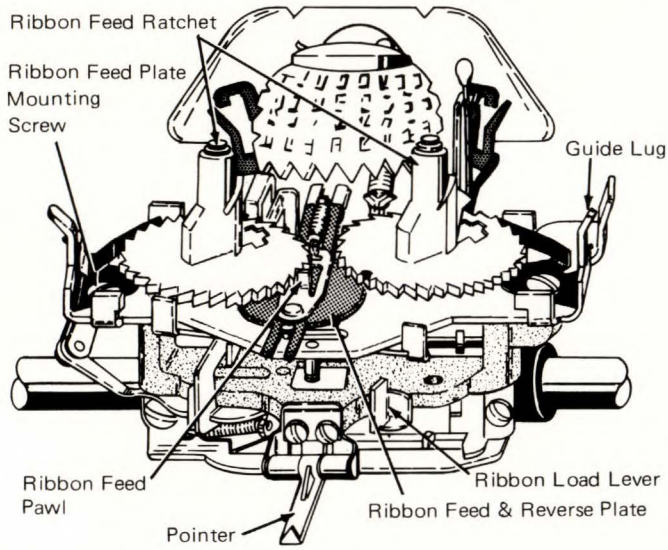


Figure 2 – Carrier Assembly (Fabric Ribbon Cartridge Removed)

The ribbon lift mechanism consists of a lift cam, a cam follower, a control mechanism, and the ribbon lift guide assembly. The lift mechanism is mounted to the carrier and moves with it. The ribbon lift cam is a single lobe cam that is setscrewed to the left side of the print sleeve. Each time a print cycle occurs the cam makes one complete revolution. (Fig. 3)

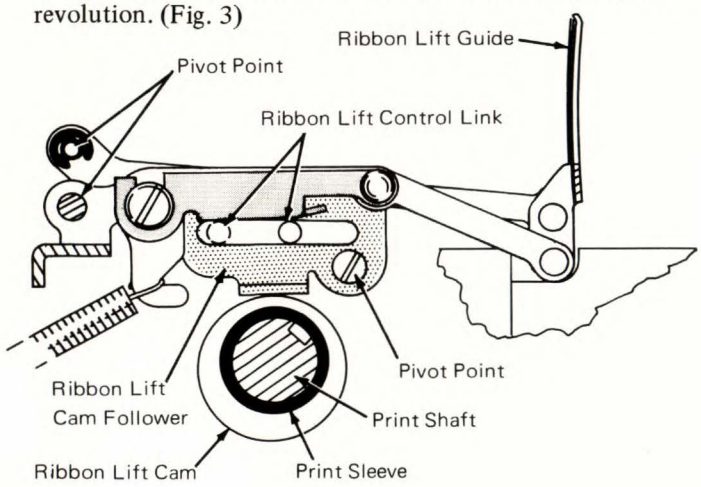


Figure 3 – Ribbon Lift Guide

The ribbon lift cam follower pivots on the carrier assembly above and to the rear of the cam. Each revolution of the cam raises the cam follower. The end of the ribbon lift control link fits into an elongated slot in the cam follower. The ribbon lift guide rests on the control link and pivots at the front of the carrier casting. As the cam follower is raised, the control link forces the ribbon lift guide assembly to pivot at the front and raise the rear of the assembly. A flat link from each side of the ribbon lift guide attaches to two pins at the front of the carrier to maintain the ribbon lift guide in a vertical position. (Fig. 4)

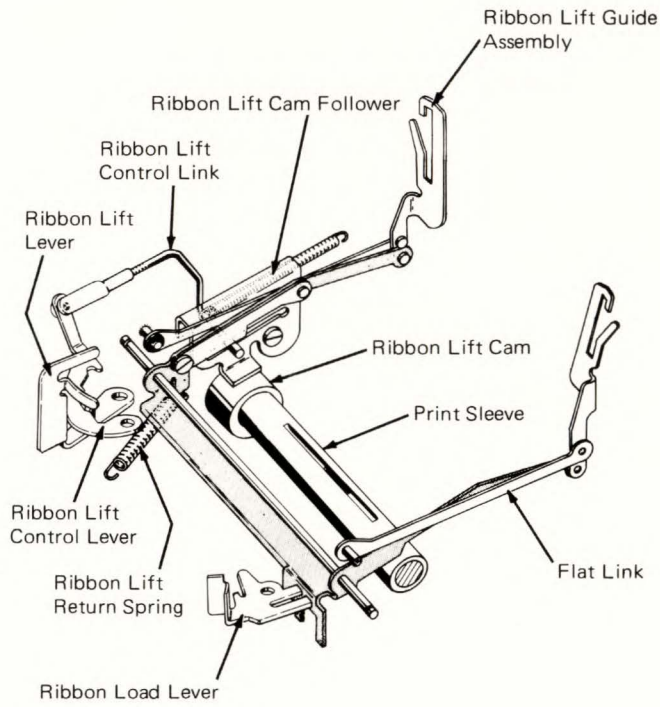


Figure 4 – Ribbon Lift Mechanism

The fabric ribbon mechanism has four lift positions. A lift position is selected by manually positioning the ribbon lift lever for stencil, low, medium, or high lift position. The height to which the ribbon will be raised is determined by the position of the ribbon lift control link in the elongated slot of the cam follower. When the control link is to the rear of the slot, no motion is transferred to the lift guide assembly. When the control link is to the front of the slot, maximum motion is imparted to the lift guide assembly.

The ribbon lift guide assembly is spring loaded into the rest position to ensure that it will restore rapidly and to prevent overthrow of the ribbon due to the momentum of the lift mechanism.

The ribbon feed and reverse mechanism is mounted at the top of the carrier just in front of the typehead. The mechanism is detachable as a unit for repair or replacement purposes.

The ribbon feed plate is made up of the following items: Two ribbon feed ratchets, the ribbon feed lever, the ratchet detent lever, the ribbon feed and reverse plate, and a bracket that is used to attach the ribbon feed lever. The feed and reverse plate has the ribbon feed pawl mounted to it with a shouldered stud so that it can pivot freely. The ribbon feed lever protrudes through an elongated slot in the feed and reverse plate so it can transfer the rotary motion of the feed cam to a front to rear motion of the feed pawl. The front to rear motion of the feed pawl is used to move a ribbon feed ratchet two teeth to the rear on each feed stroke. The ratchet to be fed is determined by the position of the ratchet detent lever.(Fig. 5)

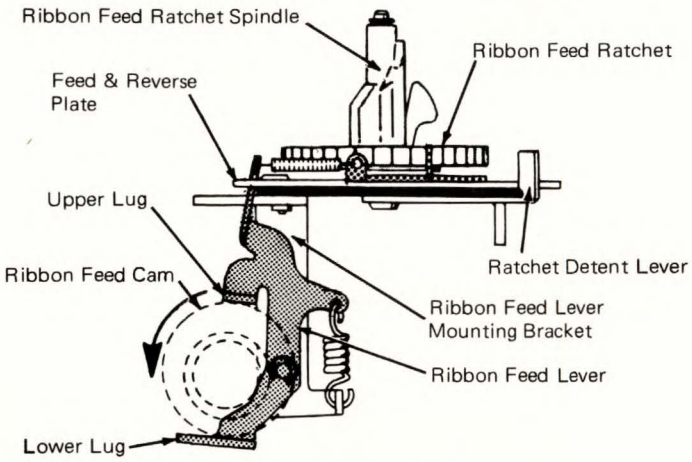


Figure 5 – Ribbon Feed Lever (Beginning Of Feed Operation)

The ribbon feed ratchet assemblies rotate freely around their respective feed ratchet spindles. The ribbon feed ratchet is designed to center the ribbon supply hub within the ribbon cartridge and lock it in place radially so that when the ribbon feed pawl moves a ratchet, the supply spool will also move. Two flat retainer springs are mounted on the ribbon feed plate at the rear so that they rest against the ribbon feed ratchets. The slight drag applied by the springs prevents the jerk of the ribbon feed operation from spinning the supply spool and spilling off excessive ribbon.(Fig. 6)

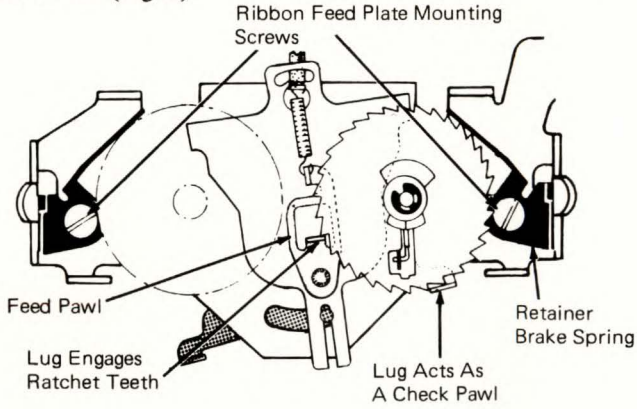


Figure 6 – Feed Pawl & Ratchet Checking

Each feed ratchet contains a small bellcrank called the ribbon reverse trigger. This trigger is spring loaded down by a small flat reverse trigger spring. The reverse trigger is held within the ribbon feed ratchet in the inactive positon as long as ribbon is around the spool. During the last revolution of the supply spool, the reverse trigger is released into the active position. This causes the lower extension of the reverse trigger to drop into the path of a notch in the feed and reverse plate. (Fig. 7)

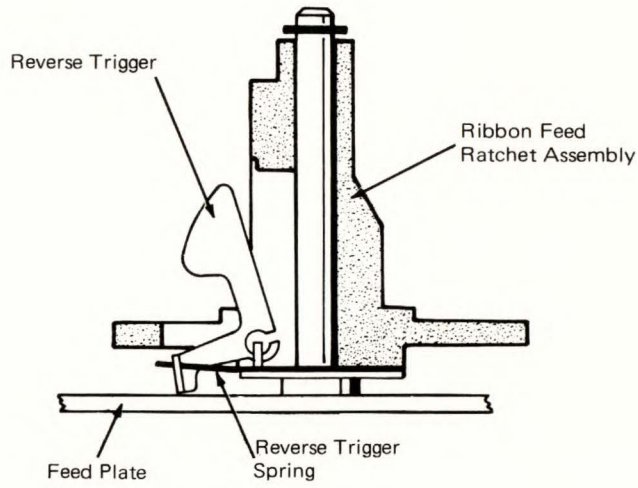


Figure 7 – Ribbon Feed Ratchet Assembly

On the forward or restoring stroke of the plate, the reverse trigger restricts one side of the plate from sliding forward. The other side continues to slide forward, thereby, causing a pivoting action to the entire plate about the point of restriction. This makes the front of the plate pivot toward the opposite side, positioning the feed pawl in line with the ratchet teeth of the ribbon feed ratchet containing the empty ribbon spool. On the next feed stroke, the feed pawl will engage the ratchet teeth of the empty spool, causing it to begin to take on ribbon.(Fig. 8)

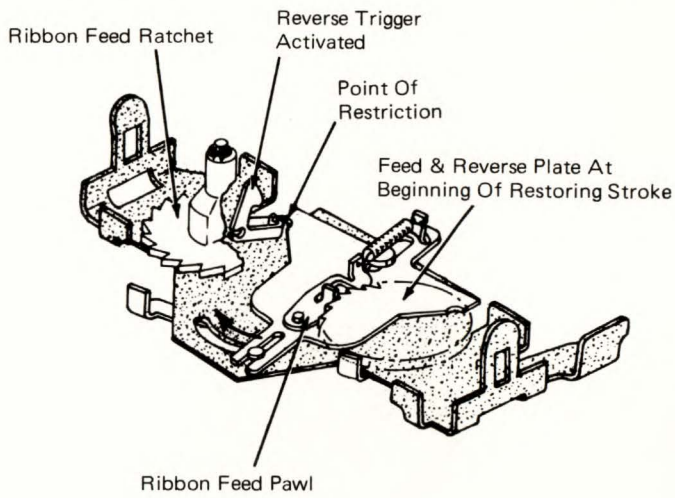
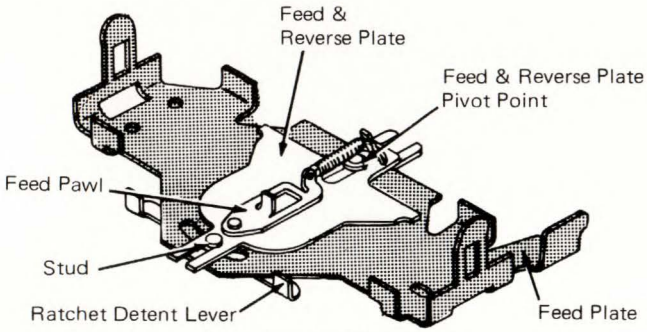
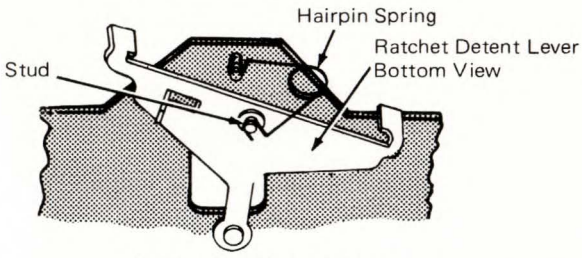

Ribbon Feed Ratchet
Reverse Trigger Activated
Point Of Restriction
Feed & Reverse Plate At Beginning Of Restoring Stroke
Ribbon Feed Pawl

Figure 8 – Reversing Operation

Since the reversing action makes the "full" take-up spool become the supply spool and the "empty" supply spool become the take-up spool, it is necessary to disengage the ratchet detent lever from one feed ratchet and engage it with the other. This is done in step with the reversing operation. (Fig. 9A) As the front of the feed and reverse plate swings, causing the feed pawl to engage with the opposite feed ratchet, it pivots the ratchet detent lever to the opposite spool. A stud riveted to the lever protrudes up through a slot in the feed and reversing plate linking the two together. A hairpin spring fastened to this stud and anchored to the feed plate provides a toggling action to both the feed and reverse plate and the ratchet detent lever. (Fig. 9B) In addition, the hairpin spring keeps the ratchet detent lever constantly spring loaded against the teeth of the feeding ratchet.



A. Reversing Operation



B. Ratchet Detent Lever

Figure 9 – Ribbon Feed & Reverse Plate Mounting

Ribbon feed is interrupted during the stencil mode of operation. This is accomplished by centering the feed pawl between the ratchet spools so it can move freely front to rear without engaging a ratchet tooth. The feed pawl is caused to operate in this manner by the ribbon lift lever when it is in the no lift or stencil position. (Fig. 10)

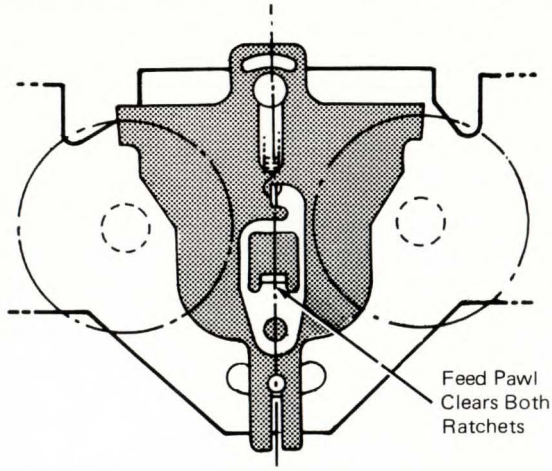


Figure 10 – Ribbon Feed Pawl (No Feed Position)

Two lugs on the ribbon lift lever form a "V" which traps a lug on the ratchet detent lever. As the ribbon lift lever is placed in the stencil position, one or the other of the lugs, depending upon which spool is being driven, will contact the lug on the ratchet detent lever and cam it to the center of the "V". At this point, the ribbon lift lever will be in a detented position and the ratchet detent lever will be centered. With the ratchet detent lever in this position, the feed pawl will be guided between the ratchet spools. (Fig. 11)

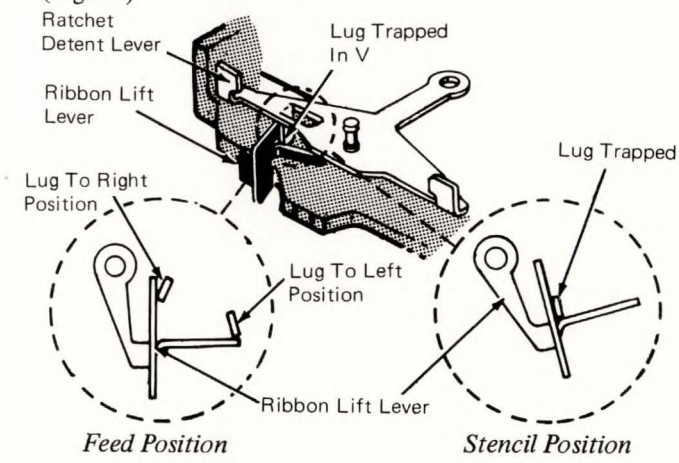


Figure 11 – Stencil Lockout

The old-level ribbon mechanism contains a few more parts than the current mechanism, however, the operation is similar. The position of the feed pawl determines which ratchet is fed as the pawl moves to the rear. The feed pawl pivots on a pin beneath the ribbon feed plate and extends up through a hole in the plate. Mounting of the pawl permits left to right as well as front to rear movement. An extension spring attached to the pawl restores the pawl to the rest position each time it operates. The spring also holds the pawl left to right into engagement with the correct ribbon feed ratchet depending upon the direction of the pull of the spring. The forward end of the spring is attached to a lever called the ribbon feed detent lever. The detent lever pivots on the ribbon feed plate. When the lever is moved to the right, the feed pawl is pivoted into engagement with the right hand feed ratchet. When the detent lever is moved to the left, the feed pawl engages to feed the left hand ratchet. (Fig. 12)

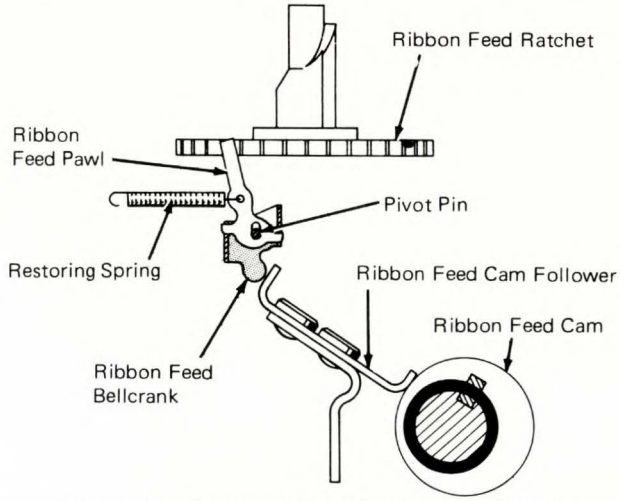


Figure 12 – Ribbon Feed Mechanism – Side View

The ribbon feed pawl is powered to the rear by the action of the ribbon feed cam. A sliding cam follower transfers the motion of the cam to the ribbon feed bellcrank which pivots and actuates the feed pawl to the rear. Sufficient motion is available from the cam to cause a two teeth feed of the ratchet. As the feed pawl restores to the front, it slides along the teeth of the ratchet into the rest position. The drag of the pawl along the teeth tends to rotate the ratchet backwards and unwind the ribbon. To prevent any backward rotation, a detent pawl is spring loaded into the teeth of the ratchet to allow feed in one direction only. (Fig. 13)

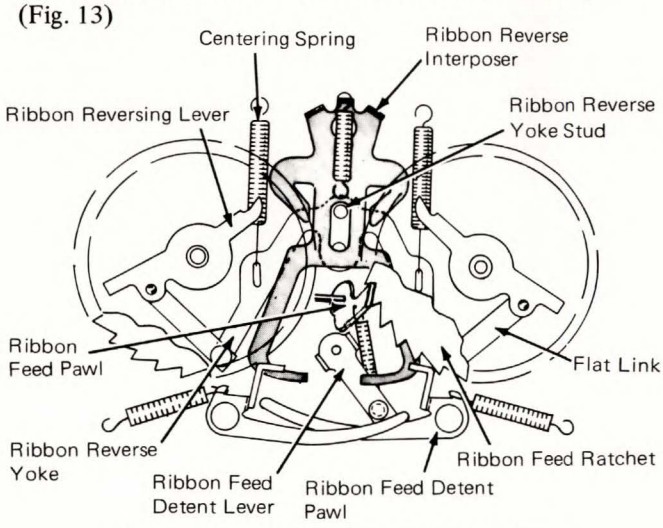


Figure 13 – Ribbon Reverse Mechanism – Rest Position

To reverse the ribbon, a portion of the reverse trigger pivots down through a hole in the ratchet into position below the ratchet as it does in the current mechanism. The empty spool rotates slightly farther causing the reverse trigger to contact and actuate the reverse lever which pivots just below the ratchet. The reverse lever is connected, by means of flat link, to an arm of the reverse yoke beneath the ribbon feed plate. The yoke is pivoted by operation of the reverse lever. A stud on the yoke at the rear of the pivot point extends up through the feed plate into a slot in the reverse interposer. Movement of the yoke positions the front of the reverse interposer left or right depending upon which ribbon spool is being emptied. (Fig. 14)

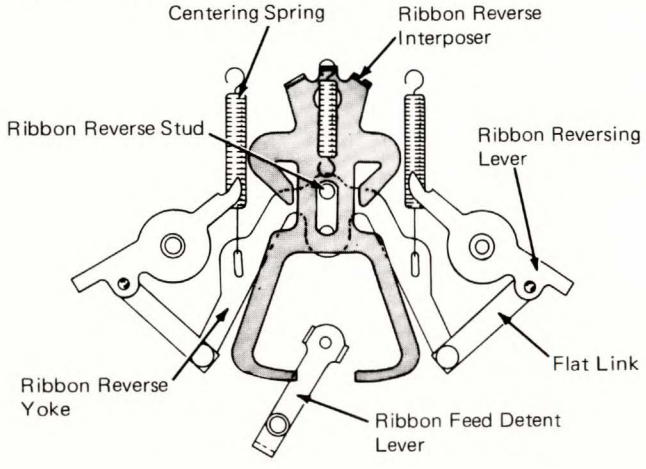


Figure 14 – Ribbon Reverse Mechanism – Rest Position

Two things occur when the reverse interposer is positioned. A hook at the front of the interposer hooks around a lug on the ribbon feed detent lever. The interposer lever, mounted on the interposer, is positioned into the path of the ribbon feed pawl. The next operation of the ribbon feed cam causes the feed pawl to drive the reverse interposer to the rear. The hook at the front of the interposer pulls the lug of the detent lever to the rear causing the detent lever to pivot to the opposite position. Movement of the detent lever disengages the detent pawl at the full spool and allows the pawl to engage the ratchet at the empty spool. As the feed pawl restores, its spring pivots it over into engagement with the opposite ratchet. (Fig. 15)

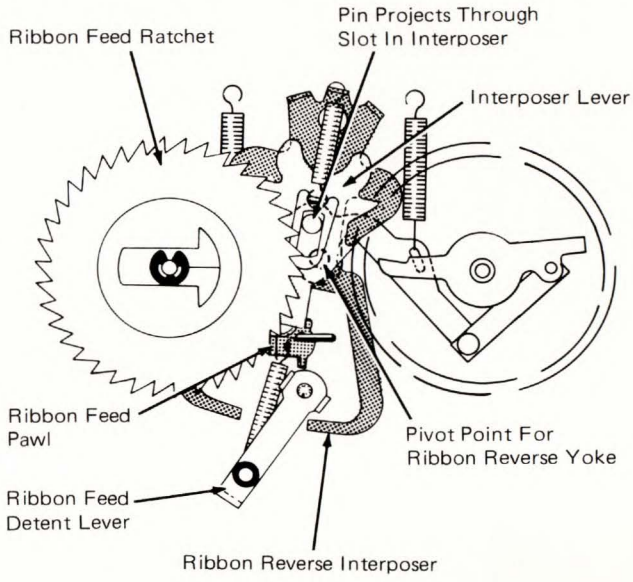
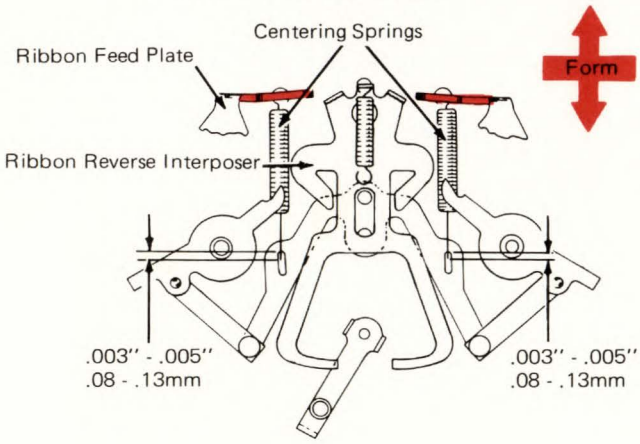


Figure 15 – Ribbon Reverse Mechanism – Active Position

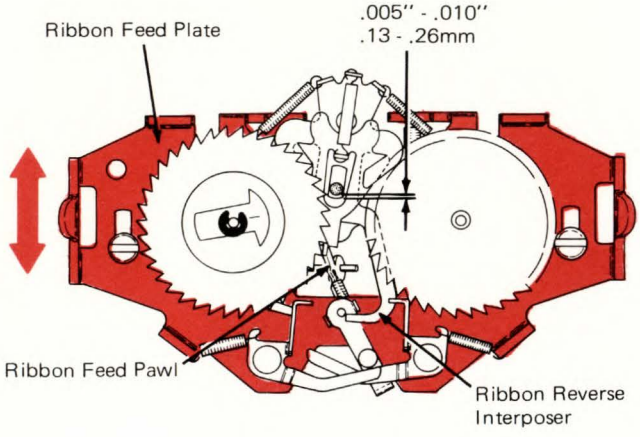
FABRIC RIBBON ADJUSTMENTS

1. *Centering Spring (Level 1 Only)* – With the ribbon reverse interposer centered, form the lugs of the ribbon feed plate for .003" - .005" clearance in the centering spring loops. This adjustment ensures that the springs are not extended when at rest and that they will properly restore the mechanism after a reverse operation.

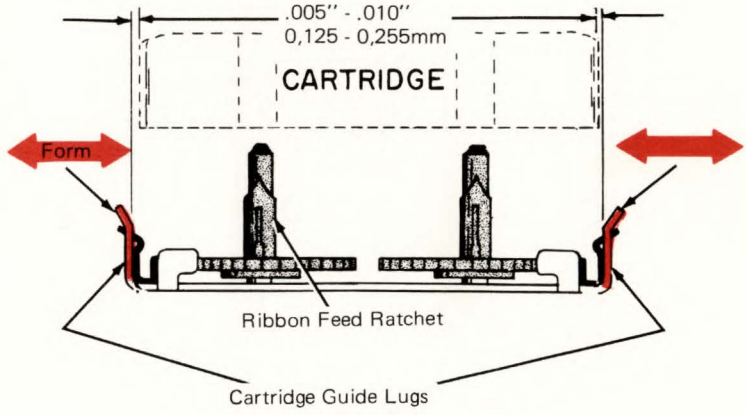


2. *Ribbon Feed Plate (Level 1 Only)* – With the ribbon mechanism set for a reversing operation and the ribbon cam at its high point, adjust the feed plate forward or back on the carrier so the ribbon feed pawl holds the reverse interposer within .005" - .010" of its total travel. This adjustment not only ensures sufficient throw for a reversing operation, but also gives optimum ribbon feed results by determining the rest and active positions for the pawl.

CAUTION: After completing the adjustment, manually cycle a character to see that two teeth feed is obtained plus .005" - .010" overthrow. Be sure that the feed pawl does not contact the interposer lever as the pawl is manually reversed from side to side.

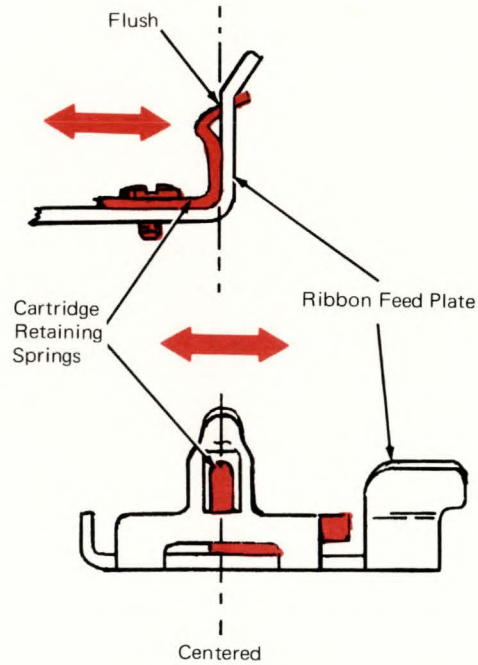


3. *Cartridge Guide Lugs:* Form the cartridge guide lugs so the cartridge spools will be centered over the ratchets. Side play of the cartridge must be limited within .005" - .010".



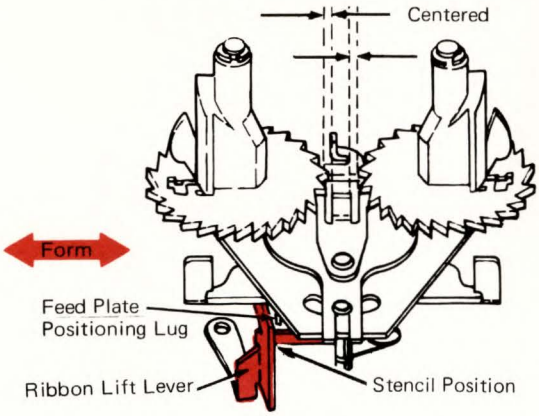
4. *Cartridge Retaining Springs (Level 2 Only)* – The cartridge retaining springs should be positioned laterally so they are FLUSH against the feed plate; then adjust front to rear so the cartridge retaining fingers are centered in the holes of the cartridge guide lugs. The ratchet brake portion of the spring should exert a small drag on the feed ratchet. Form only as necessary.

Note: Excessive or insufficient tension could result in reverse failure.

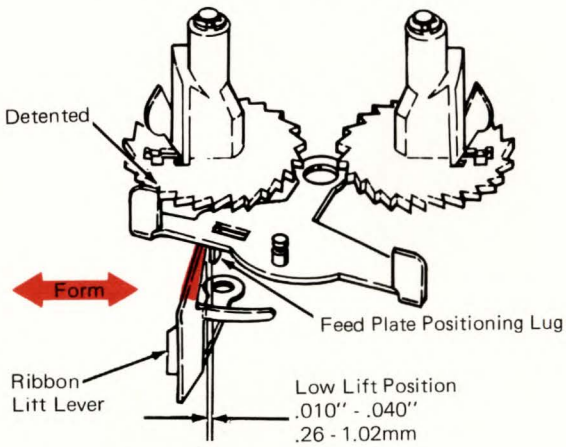


5. *Ribbon Lift Lever (Level 2 Only)* – Three conditions must be met as follows:

a. Form the lift lever finger tab left or right so the ribbon feed pawl will center between the two feed ratchets when the lift lever is placed in stencil position.

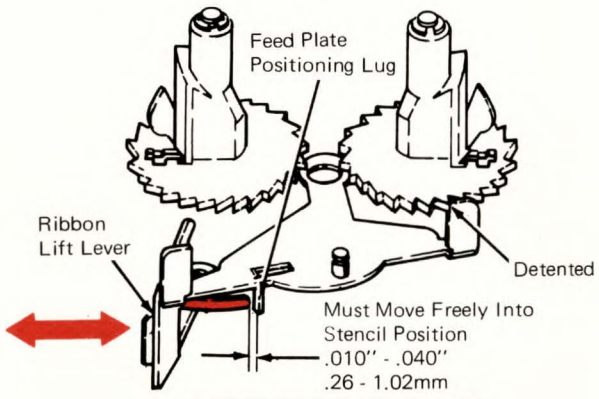


b. Form the rear lug so a clearance of .010" - .040" exists between the lug and the feed plate positioning lug when the LEFT HAND RATCHET IS FEEDING.



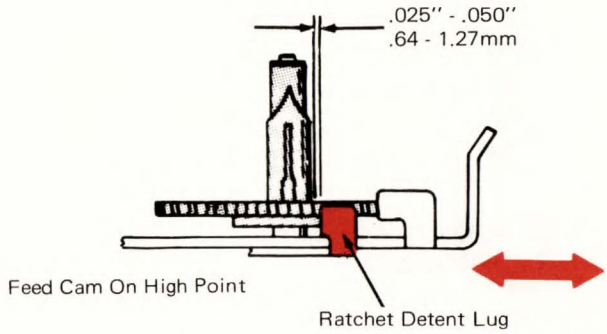
c. Form the front lug so a clearance of .010" - .040" exists between the lug and the feed plate positioning lug when the RIGHT HAND RATCHET IS FEEDING.

Note: Avoid forming the ribbon feed plate positioning lug, since the breakage would require replacement of the entire feed plate.



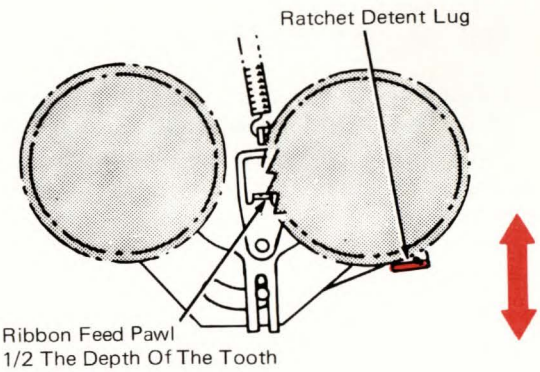
6. *Ratchet Detent Lever Lugs* – These should be formed as follows:

a. Left or right, so the ribbon feed ratchet tooth overthrows past the edge of the detented lug by .025" - .050" when hand cycling to the high point of the ribbon feed cam.



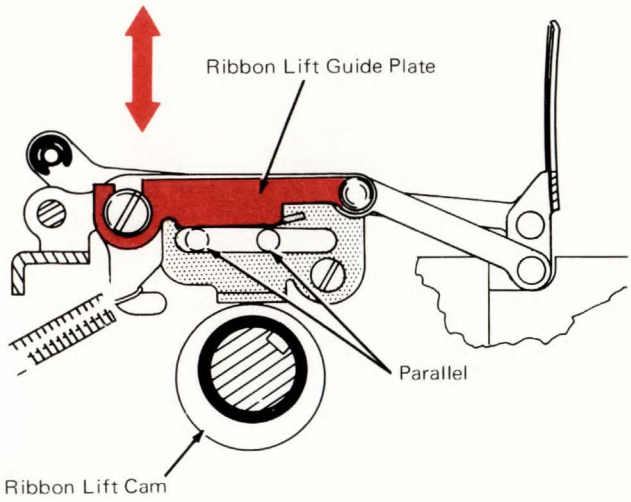
b. Form the detent lugs front to rear so the ribbon feed pawl engages a ratchet tooth by approximately 1/2 the depth of the ratchet tooth.

Note: The feed pawl spring lug should clear the teeth of the opposite ratchet by at least .015" when the feed pawl is being withdrawn to the rest position at the end of an operation. Failure to clear the teeth of the opposite ratchet under power may result in a lockup and consequent failure of the ribbon feed operation.



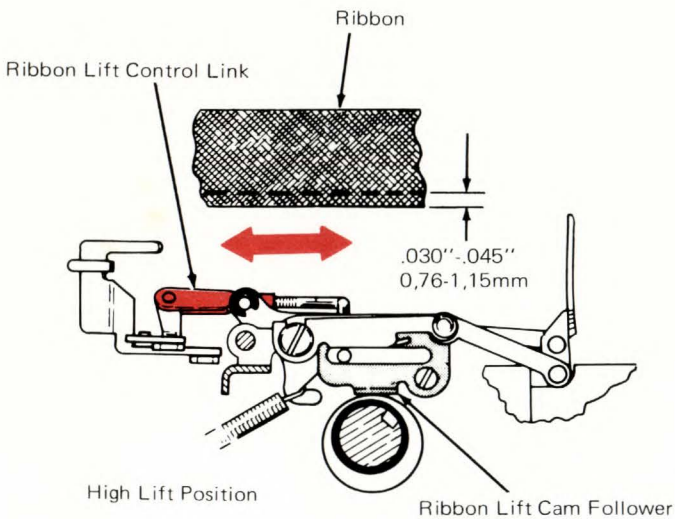
7. *Ribbon Lift Guide Plate* – Adjust the plate as low as possible without causing a change in the ribbon lift guide height as the ribbon lift lever is moved from the low lift to the high lift position. The ribbon lift cam should be at the low point when the check is made.

   This adjustment ensures the same relative throw for both the high and low lift position.

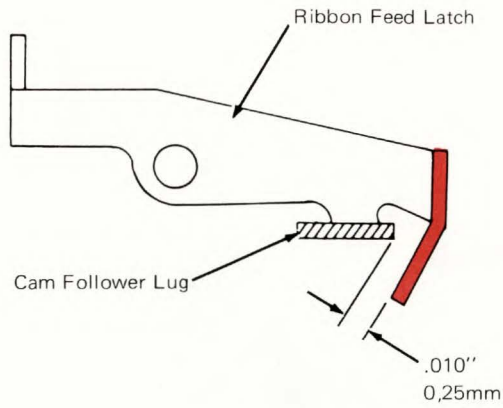


8. *Ribbon Lift Control Link* – Adjust the link forward or back by means of its clevis so the underscore will strike the ribbon .030" - .045" from the bottom edge. The ribbon lift lever must be in the high lift position when this check is made.

   CAUTION: Do not adjust the link so short that it chokes off the front end of the cam follower slot as the ribbon lift lever is moved into the high lift position.



9. *Stencil Lockout (Level 1 Only)* – With the lift lever in the stencil position and the cam follower on the high point of the ribbon feed cam, form the ribbon feed latch for .010" clearance with the lug on the cam follower.



The term "margin" is defined as the distance between the edge of the paper and the typewritten material. The purpose of the margin mechanism is to allow the operator to vary the length of the writing line. The left and right hand margins are determined by the position of the margin stops on the margin rack. The carrier travel is restricted by the position of the margin stops. (Fig. 1)

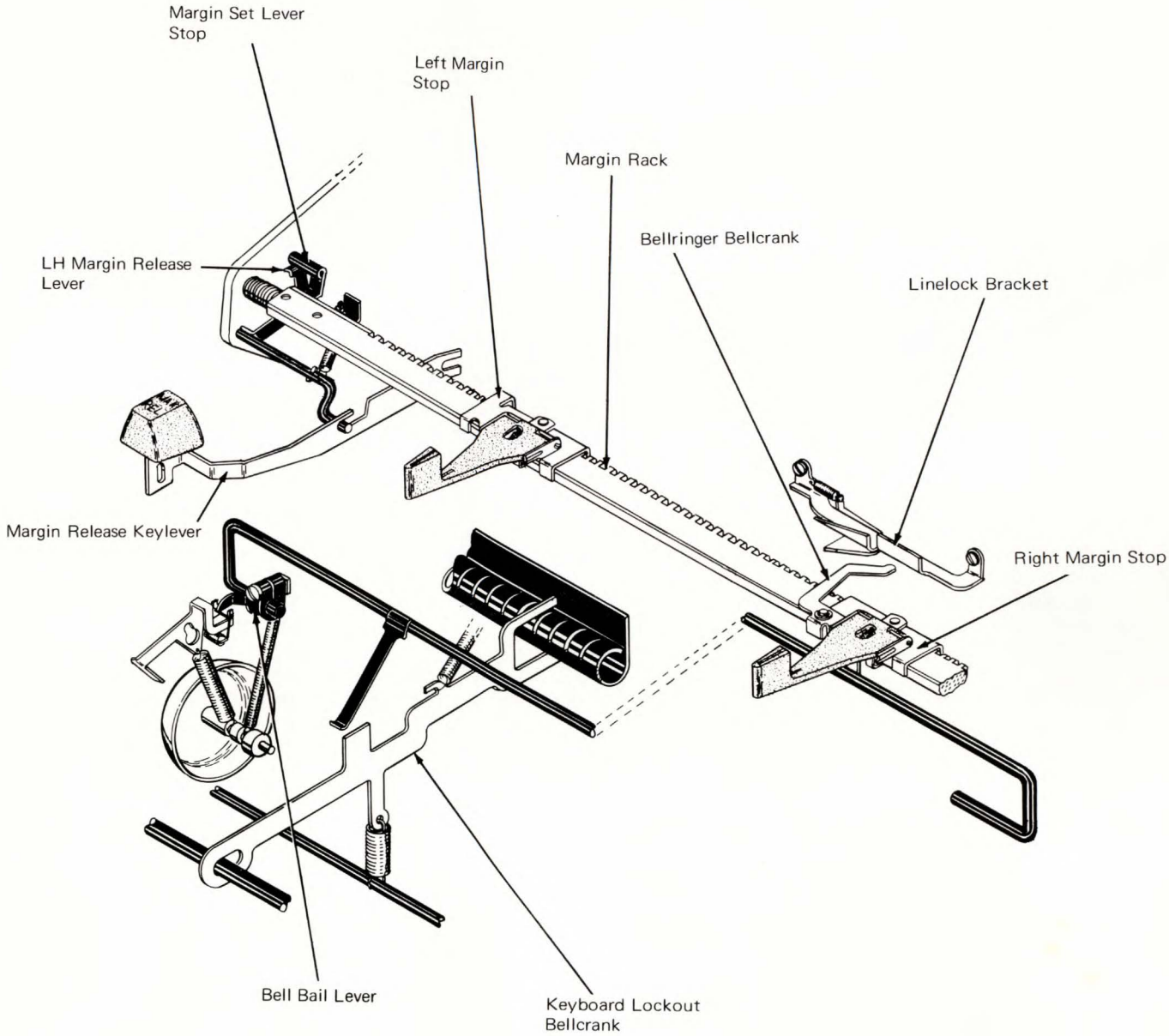


Figure 1 – Margin and Linelock Mechanism

The margin rack is a flat rack containing teeth along its rear edge. The number of teeth per inch in the margin rack corresponds to the pitch of the machine.

Each margin stop has a pin and slider assembly that meshes with the teeth at the rear of the margin rack. Each margin stop has a margin set lever attached to the pin and slider assembly. The margin set levers extend through a slot in the front case of the machine to make them accessible to the operator. Either margin stop may be repositioned by pushing the margin set lever to the rear to disengage the pin from the rack, then, by sliding the margin stop along the rack to the desired location. A line on each margin set lever serves as a pointer to indicate the position of the margin stop in relation to the scale on the front of the case. A pointer, located on the front of the carrier, indicates the position of the carrier. (Fig. 2)

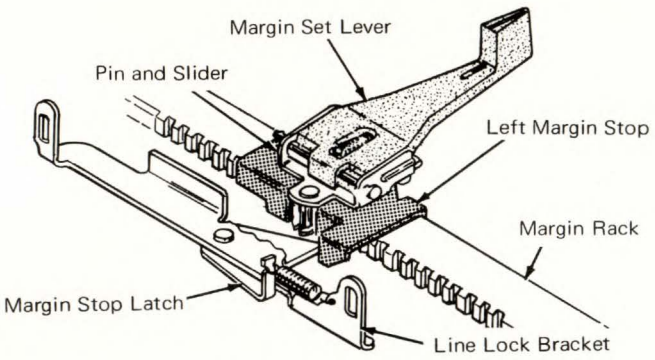


Figure 2 – Left Margin Mechanism

The left hand margin stop controls the left margin. When the carrier is returned by the carrier return mechanism, an extension of the left hand margin stop is struck by the margin stop latch pivoted on the linelock bracket attached to the carrier. This action forces the margin rack to the left to unlatch the carrier return mechanism and leaves the carrier resting at the left margin position.

The right hand margin stop operates the linelock mechanism which in turn locks the keyboard when the carrier has reached the right hand margin. With the keyboard locked, the operator cannot continue typing at that position. However, the right hand margin linelock mechanism only locks the keyboard. The spacebar, backspace, tab and carrier return are not affected. (Fig. 3)

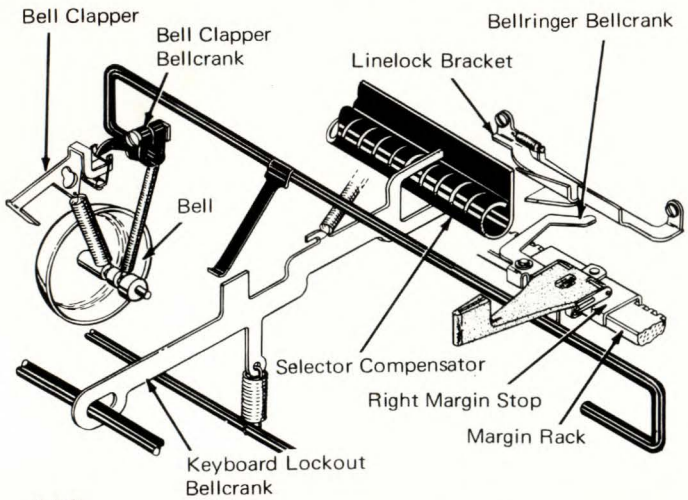


Figure 3 – Bellringer Mechanism

In addition to operating the linelock, the right hand margin stop also rings a bell several spaces before the linelock action occurs. The bell warns the typist that the carrier is near the margin stop and in most cases allows sufficient space to complete a word or phrase before the linelock occurs.

If the typist continues typing after the bell rings, the keyboard is locked after several spaces to prevent typing in the margin. The keyboard is locked by forcing a special bellcrank into the selector compensator tube to prevent the depression of any other interposer. (Fig. 4)

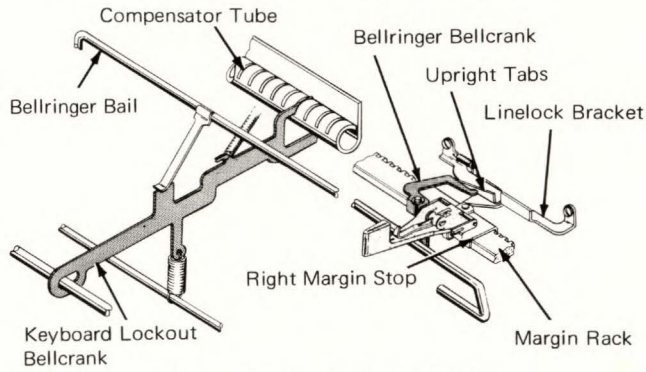


Figure 4 – Linelock Mechanism

As the carrier approaches the right hand margin, the bellringer bellcrank slides over two upright tabs on the linelock bracket. This causes the bellringer bellcrank to pivot about its mounting stud and cam the bellringer bail to the front of the machine. An extension of the bellringer bail forces the keyboard lockout bellcrank into the selector compensator tube.

As the bellringer bail is cammed to the front of the machine, the bell clapper bellcrank pivots the bell clapper away from the bell. (Fig. 5 & 6) Further rotation of the bail causes the bell clapper bellcrank to slip off the bell clapper allowing the bell clapper to restore to rest. (Fig. 7) The pull of the bell clapper spring and the momentum of the bell clapper returning to rest causes it to overthrow its rest position and strike the bell. When the bellringer bail is allowed to restore, the bell clapper bellcrank resets above the bell clapper ready for the next operation.

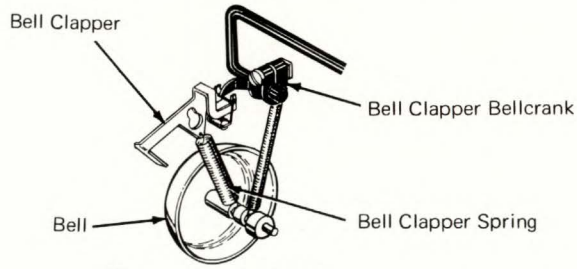


Figure 5 – (At Rest)

Figure 6 – (Mid-Point)

Figure 7 – (Drop Off Bell Rings)

Bell Clapper Mechanism

The margin release mechanism allows an operator to type beyond the left and right margins without changing the position of the margin stops. The margin release operates by rotating the margin rack so the margin stops move upward out of the path of the linelock bracket on the carrier. (Fig. 8)

The margin release keylever pivots at the left side of the keyboard. Depression of the margin release keylever causes the rear of the margin rack to rise. A lug on the left end of the margin rack remains in the path of the carrier to unlatch the carrier return if it is operated with the margin release keylever depressed. An extension spring restores the mechanism and holds it in the rest position.

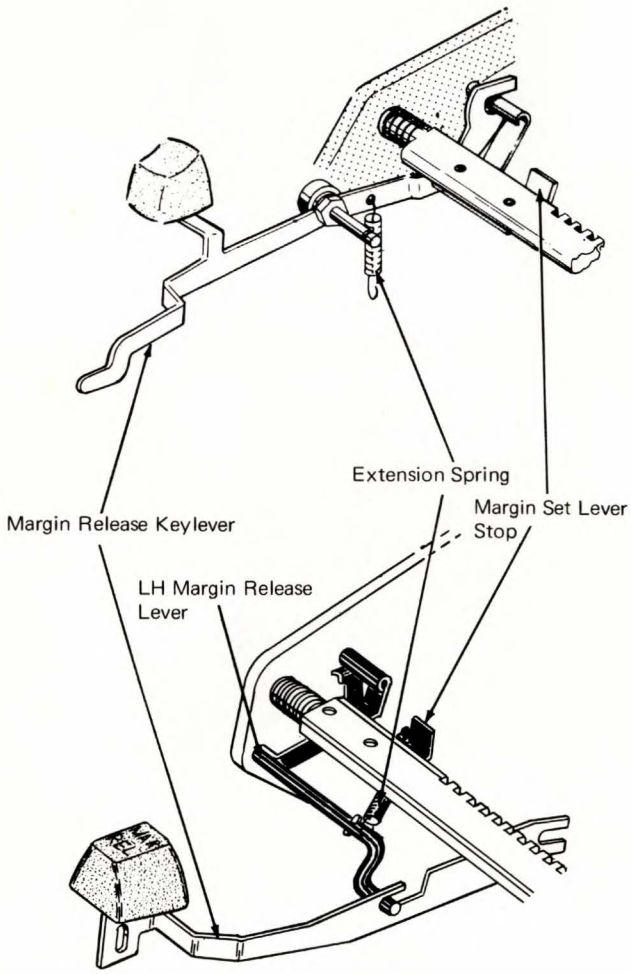


Figure 8 – Margin Release Mechanism

The margin stop latch, mounted on the linelock bracket, has an elongated mounting hole. It is spring loaded to the left so when the margin release is depressed the stop latch will snap to the left, under the margin stop. This eliminates the need for the operator to hold the margin release depressed while backspacing or carrier returning into the left margin. (Fig. 9)

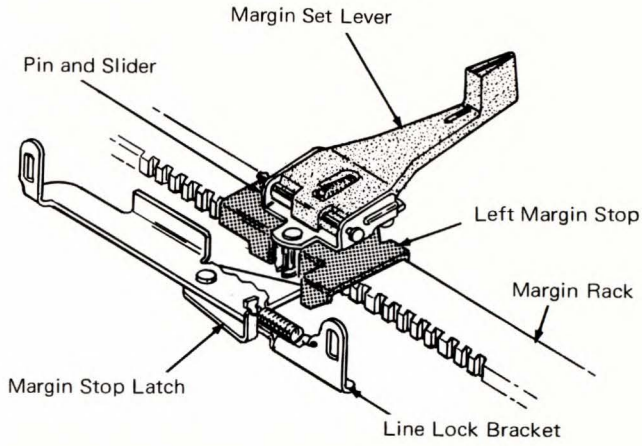


Figure 9 – Left Margin Mechanism (Margin Released)

The old level linelock mechanism locked the keyboard in the same manner as the present mechanism. However, the keyboard lock interposer was composed of several parts. The bellringer bail operated the keyboard lock interposer which through an extension spring pulled the keyboard lock bellcrank into the compensator tube. (Fig. 10)

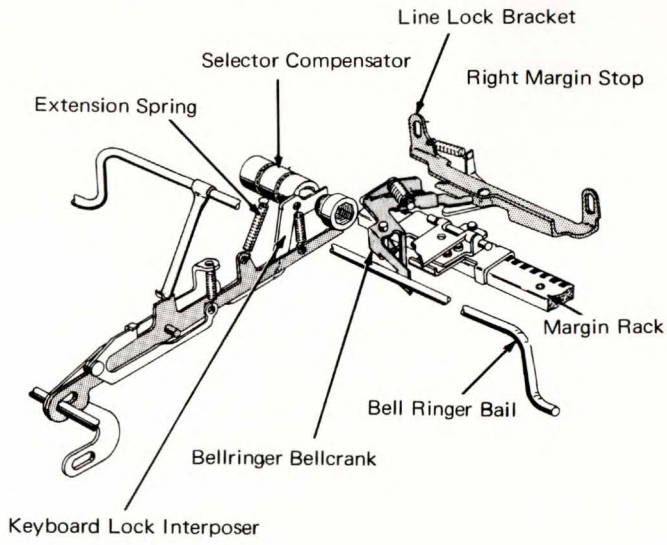
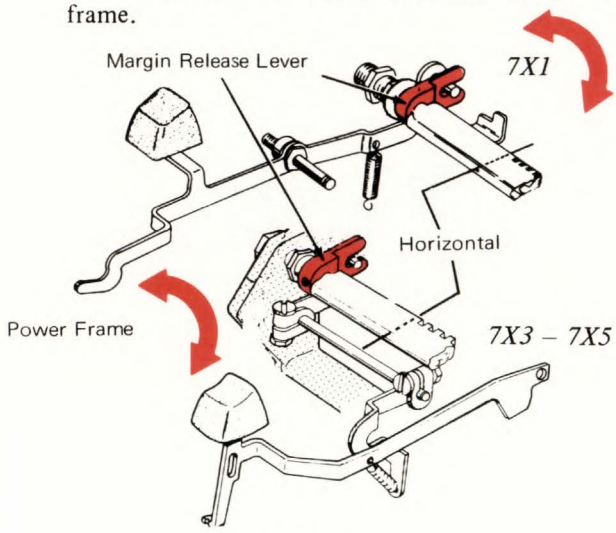
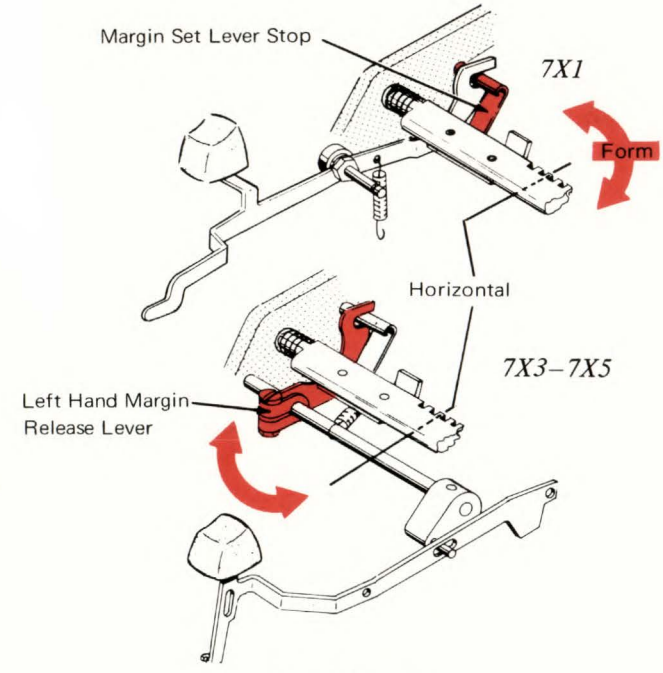


Figure 10 – Line Lock Mechanism – Old Style

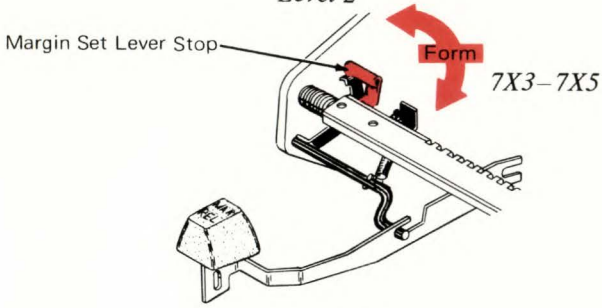
1. *Margin Rack Horizontal* – The margin rack must rest on a horizontal plane. Adjust the margin release lever on Level 1 machines. Form the margin set lever stop on 7X1 Level 2 and 7X3-7X5 Level 3 machines. Adjust the left hand margin release lever on 7X3, 7X5 Level 2 machines. Maintain .030" between the release lever and the power frame.



Level 1

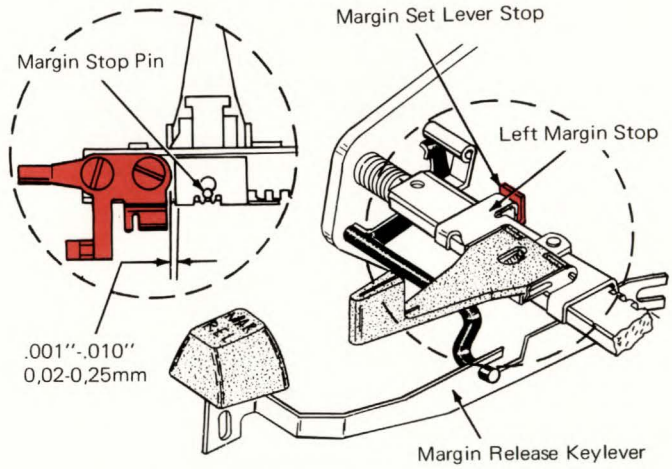


Level 2

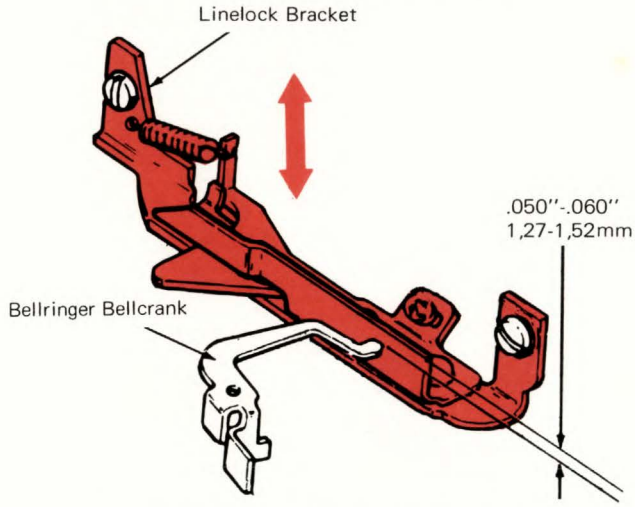


Level 3

2. *Left Hand Final Stop* – Position the margin set lever stop left to right on the margin rack so it will clear the margin stop by .001"-.010" when the margin stop pin is fully seated in the extreme left hand tooth of the margin rack.

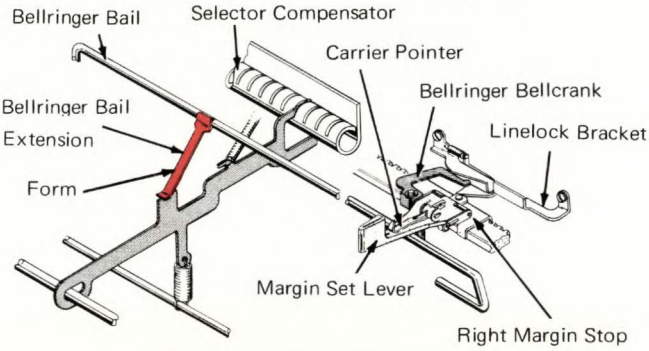


3. *Line Lock Bracket* – Adjust the linelock bracket up or down so the bellringer bellcrank contacts the bracket .050"-.060" from the top.



4. *Bellringer Bail Extension* – Form the bellringer bail extension up or down so the character keybuttons lock when the red pointer is directly above the right hand margin set lever.

CAUTION: The linelock should not be felt in the space preceding the desired locking point.



The cover assembly for the "Selectric" typewriter is composed of three major sections. They are the top cover, center cover and bottom cover. (Fig. 1)

Near the front of the top cover are two spring clips. When the cover is in its lowered position, the spring clips latch the cover in place to prevent vibration.

A margin scale is attached to the lower lip of the top cover. The scale is graduated to correspond to the pitch of the typewriter. The margin scale is attached to the top cover by an adhesive that becomes active when IBM cleaning fluid is applied.

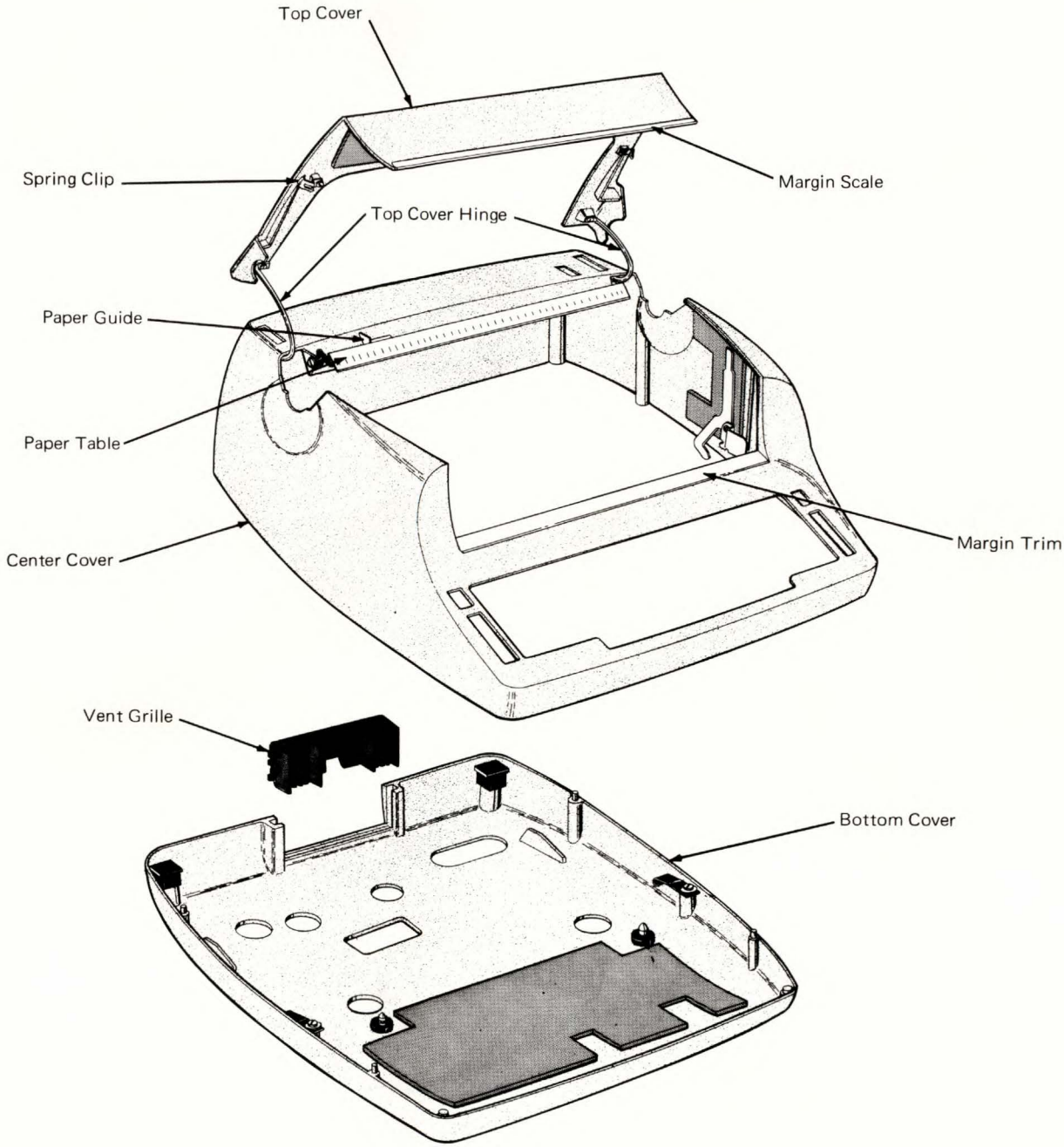


Figure 1 – Cover Assembly (Level 3)

The top cover is attached to the center cover by a hinge at the rear. The hinge brackets are adjustable front to rear to allow for proper fit between the top cover and center cover. The hinge contains a detent that prevents the top cover from falling when it is in the raised position. (Fig. 2)

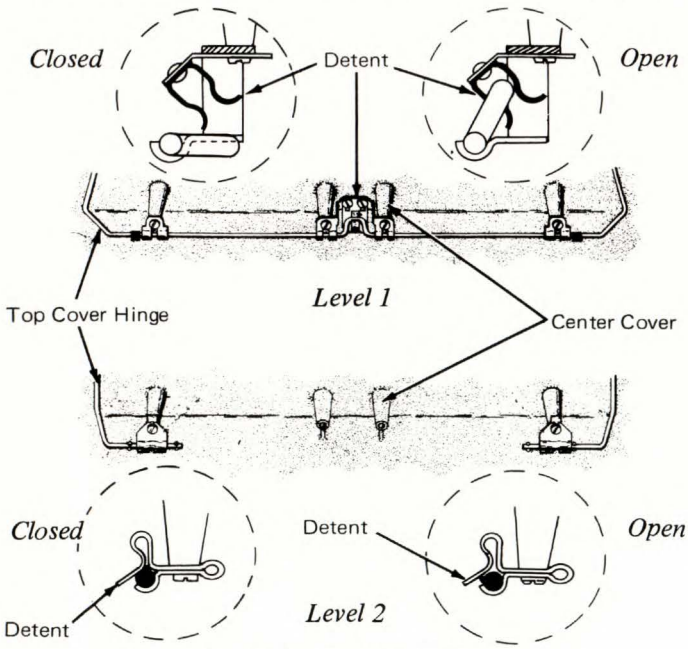


Figure 2 – Top Cover Hinge

The center cover assembly has the paper guide attached to it. The paper guide may be removed by sliding the guide to the extreme right and pulling straight downward. A section of the cover material has been removed on the rear side to permit the guide to slide off easily. The paper table is connected to the center cover assembly by two screws and two brackets. The paper table pivots on two studs mounted on the bracket to allow the platen to be removed from the machine. (Fig. 3)

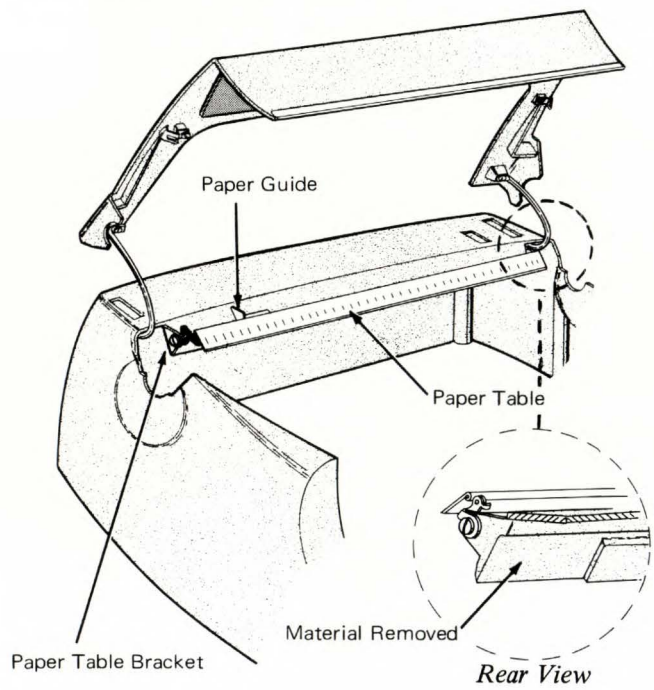


Figure 3 – Center Cover And Paper Table

There are three basic levels of center and bottom covers used on the "Selectric" typewriter. The level 3 cover has been used since 1965 and is the easiest to identify. This cover has a latch extending vertically just inside the right and left side of the center cover. (Fig. 4) The absence of the level 3 cover latches identify a level 1 or level 2 cover which are similar to each other.

The cover latches are attached to the center cover by a bracket and a mounting screw. With the lever to the rear, the lower portion of the cover latch fits beneath the latching surface attached to the bottom cover. Pulling the lever toward the front of the machine will cause the lower part of the latch to pivot to the rear, out from beneath the latching surface. The top and center cover may now be removed from the bottom cover.

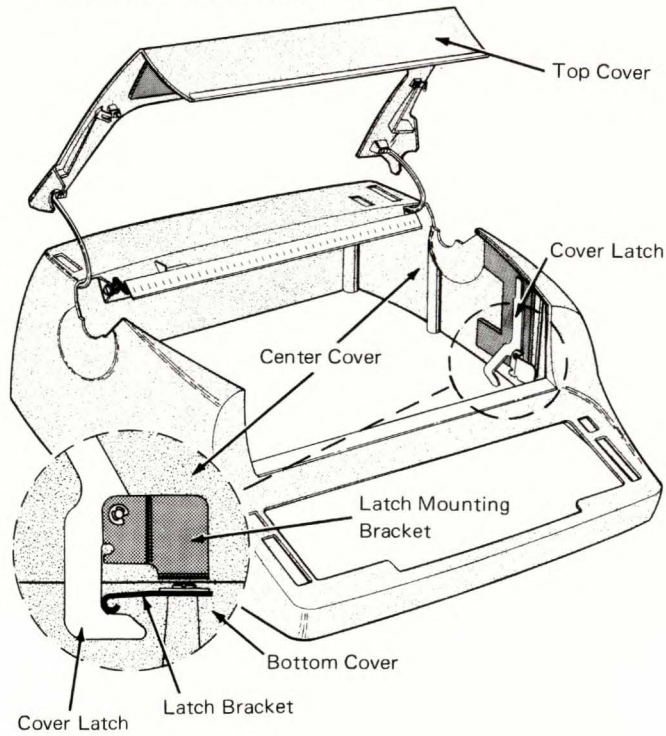


Figure 4 – Center Cover Latches (Level 3)

The level 3 bottom cover has the vent positioned in a slot at the rear. The rubber mounting to suspend the typewriter inside the case is also contained within the bottom cover. (Fig. 5)

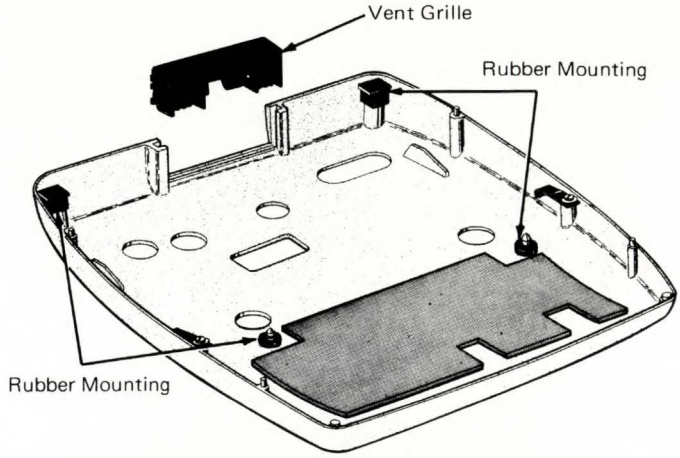


Figure 5 – Bottom Cover Rubber Mounting (Level 3)

The machine mounting brackets are attached to the machine frame and are adjustable vertically. A latch lever locks the machine to the rubber mounting foot on the left side of the machine. (Fig. 6)

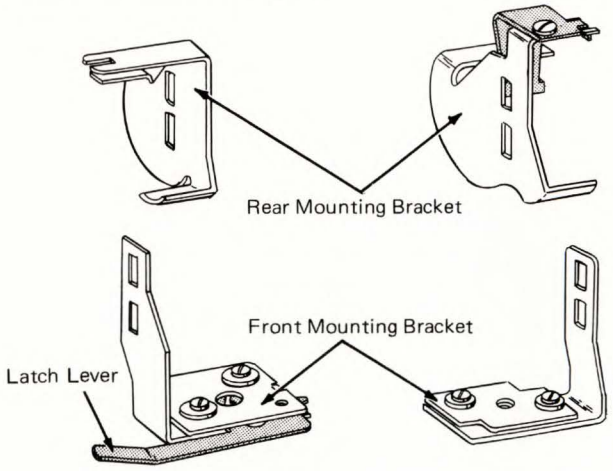


Figure 6 – Frame Mounting Brackets (Level 3)

The level 1 and level 2 center cover assemblies have the vent grille mounted in the rear by a plate. Slotted holes in the plate allow the vent to be removed without removing the plate from the center cover. (Fig. 7)

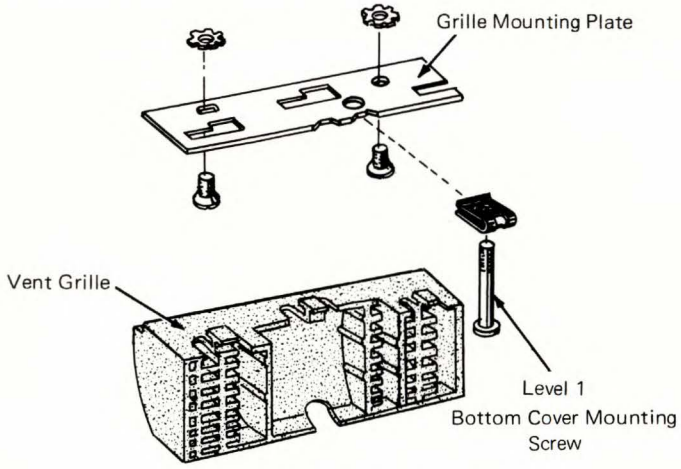
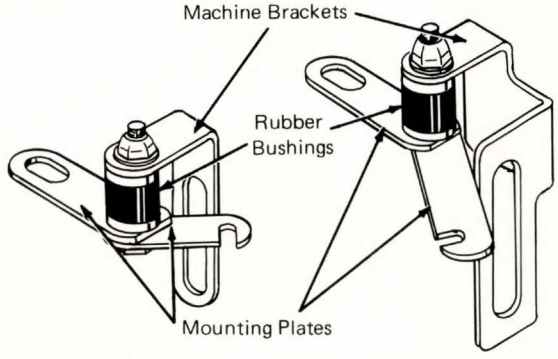


Figure 7 – Vent Grille Mounting

The level 1 and level 2 cover assemblies are mounted to the machine by brackets secured to the center cover assembly by mounting plates. The machine is suspended on rubber bushings attached to the mounting plates. (Fig. 8)



Front Mount *Rear Mount*

Figure 8 – Center Cover Frame Brackets (Level 1 & 2)

The level 1 bottom case is held in place by a screw at the center rear. The level 2 bottom case is held in place by friction fit and does not use the rear mounting screw. (Fig. 9)

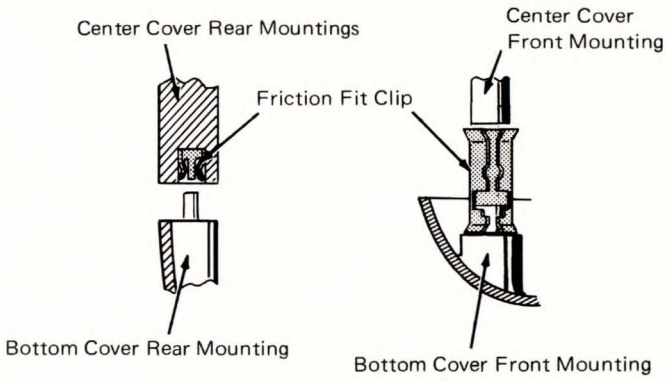


Figure 9 – Friction Fit Cover Clips (Level 2)

There are two levels of black dust shields located just below the carrier. The level 1 dust shields are metal and are held in place by three screws and a nut. The level 2 dust shields are plastic and snap into the power frame at the rear and into three mounting brackets at the front. (Fig. 10)

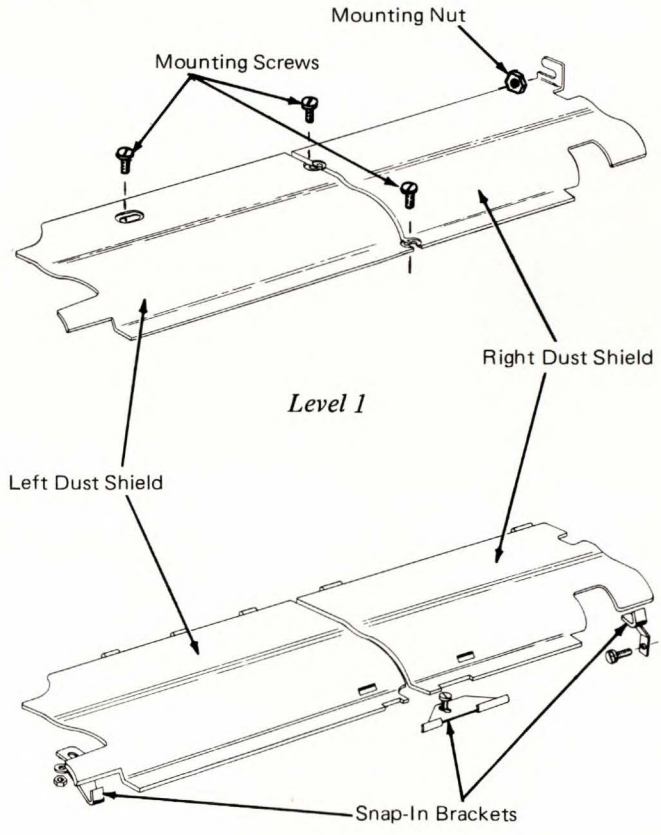
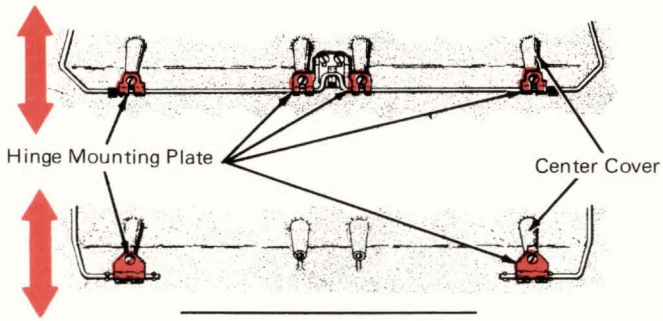
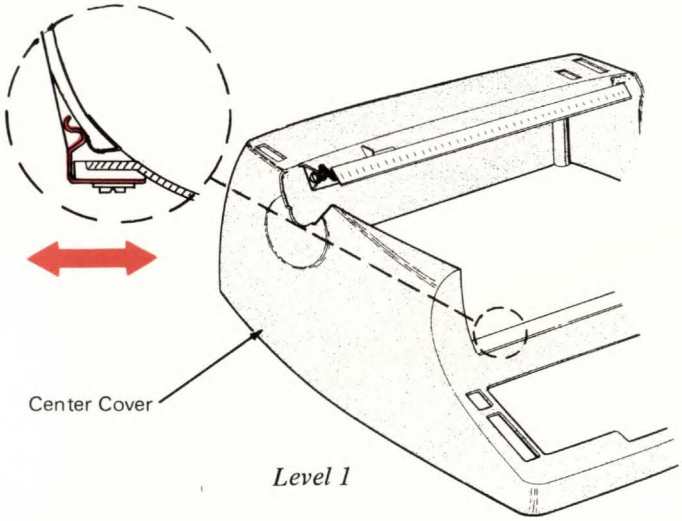


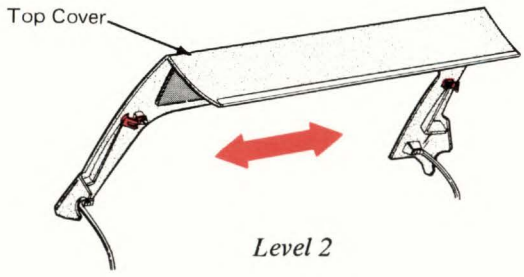
Figure 10 – Dust Shields

1. *Top Cover Hinge* – The top cover hinge should be adjusted so the contour of the top cover matches the contour of the center cover. Position the hinge mounting plate front to rear to obtain this condition.

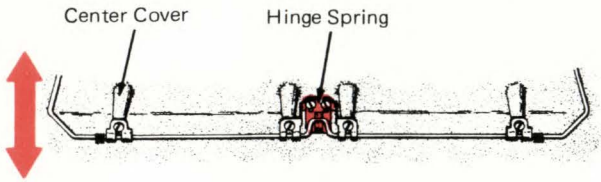


2. *Top Cover Latches* – Form the level 1 latches front to rear and adjust the level 2 latches left to right so the top cover is latched securely in the closed position.





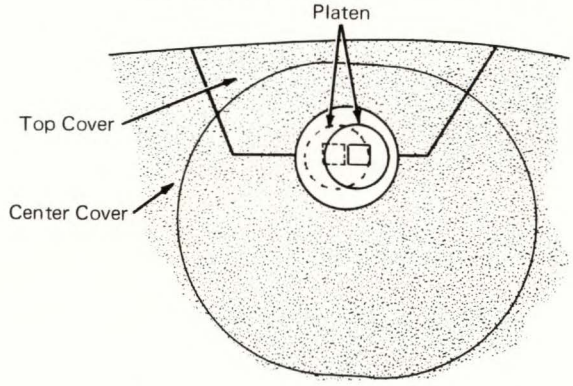
3. *Hinge Spring (Level 1 Only)* – The hinge spring should be positioned front to rear so the top cover hinge is detented and held in the open position.



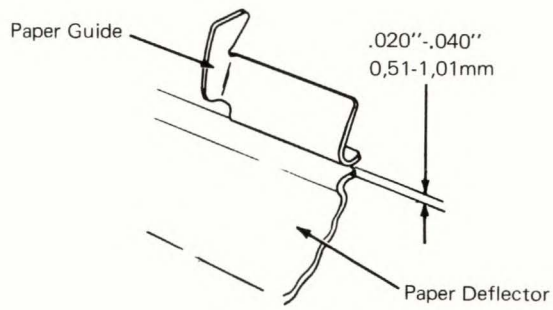
4. *Cover Mounts* – Adjust the cover mounting brackets so the machine will be positioned in the covers and the following requirements are met.
   a. All of the openings for the keybuttons will have equal clearance on each side.

Equal Clearance With All Keybuttons

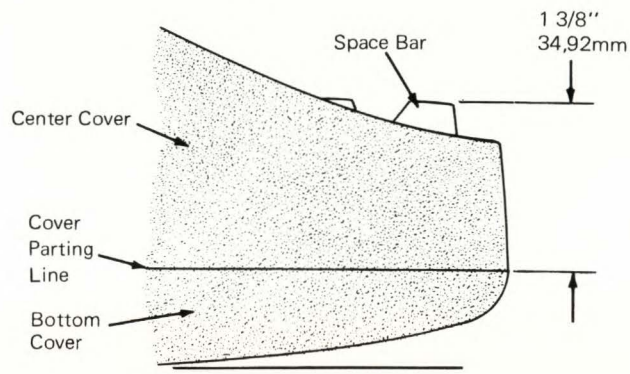
   b. The platen will clear the covers in the extreme front or rear position.



   c. The clearance between the paper guide and the deflector will be .020"-.040".



   d. The top of the spacebar will be 1 3/8" above the parting line of the cover.



CARD HOLDING PLATEN OPERATIONAL THEORY

The purpose of the card holding platen is to keep cards from slipping while being typed on. The blade of the card holding platen has a groove under both edges to allow a card to be held by either the top or the bottom. A movable card stop is mounted on the blade to assist in positioning the card laterally in the card slot. (Fig. 1)

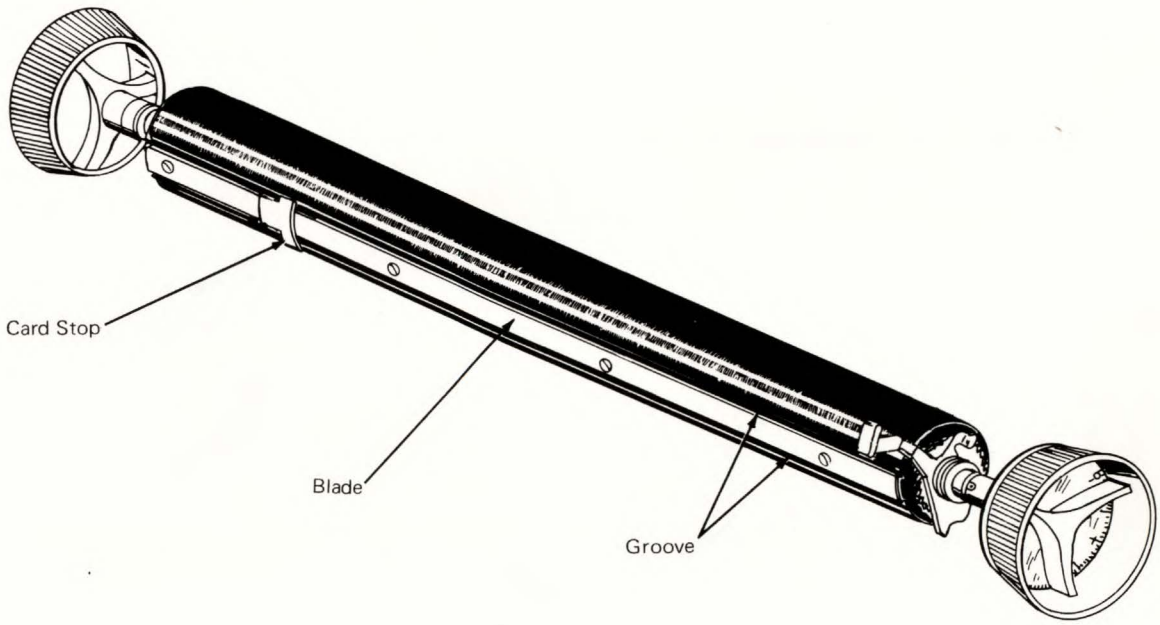


Figure 1 – Card Holding Platen

There are no adjustments on a card holding platen.

DEAD KEY MECHANISM OPERATIONAL THEORY

The purpose of the dead key mechanism is to prohibit escapement on certain predetermined keyboard positions. This mechanism is used with several foreign keyboards. We will refer to the Tri-Lingual Keyboard for discussion purpose. (Fig. 2)

On the Tri-lingual Keyboard the characters in position 41 and 42 are accent marks used with the vowels in certain words to indicate pronunciation. These are "dead key" characters, and when they are typed, the carrier does not escape. The next character typed will appear directly beneath the accent mark.

In order to prohibit escapement, a 7th selection bail is installed in the keyboard. With the typewriter sitting on its back, the dead key bail is the bottom bail. The interposer for a dead key position has an extra lug to operate this bail. Attached to the bail is a finger over which the eye of a cable is located. This cable is very similar to the cable used to control impression. The sheath of the cable is held rigid by two brackets, one for each end, mounted to the power frame. The rear end of the cable is attached to a hole in the bottom of the escapement trigger. (Fig. 3)

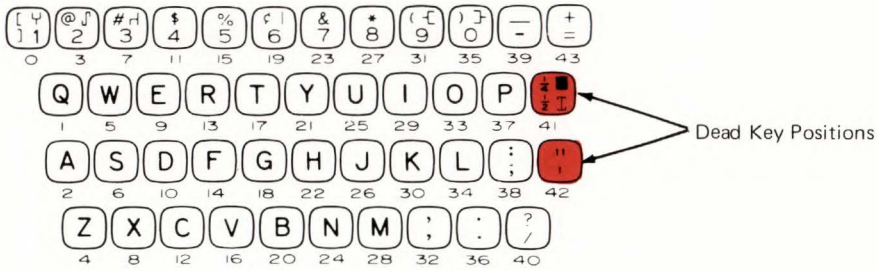


Figure 2 – 74 Tri-Lingual Keyboard

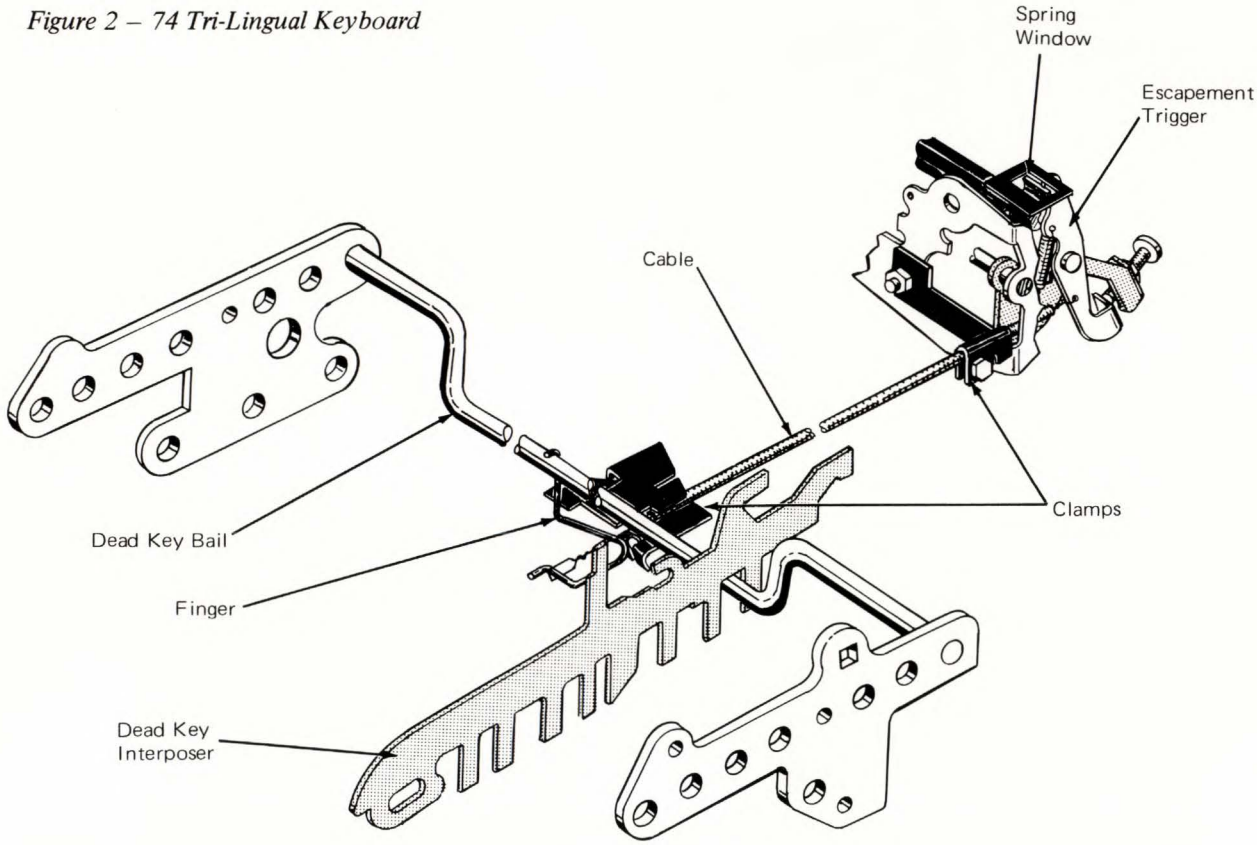


Figure 3 – Dead Key Mechanism

When an interposer in a dead key position is driven forward by the filter shaft, the rear lug on the interposer pulls the dead key bail forward. The finger on the dead key bail pulls the dead key cable which pivots the escapement trigger away from the lug on the escapement torque bar. A spring window which normally rides on the top of the escapement trigger is allowed to fall in front of the escapement trigger as the trigger pivots. This prevents the trigger from restoring over the torque bar lug until the end of the print cycle. When the escapement mechanism operates, the trigger is away from the torque bar lug, thus preventing escapement. (Fig. 4)

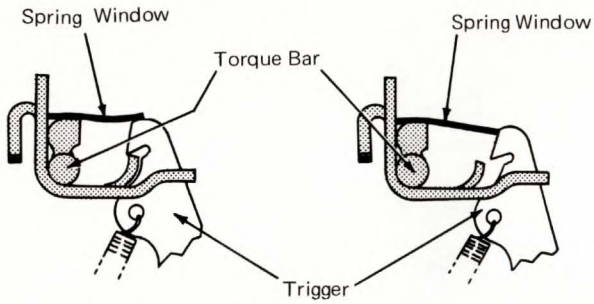
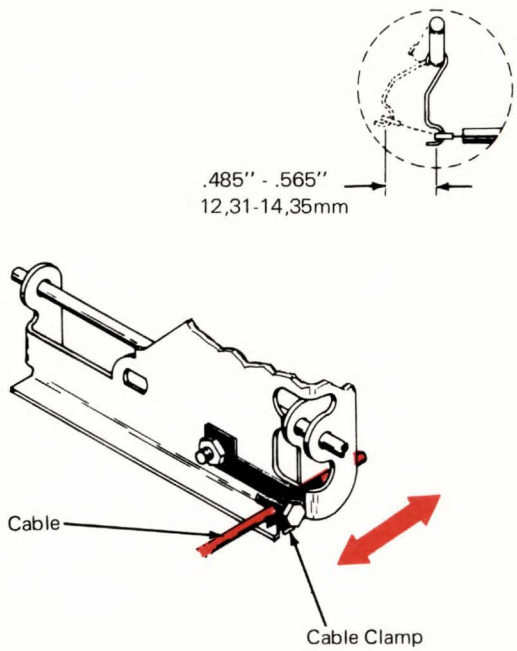


Figure 4 – Spring Window Operation

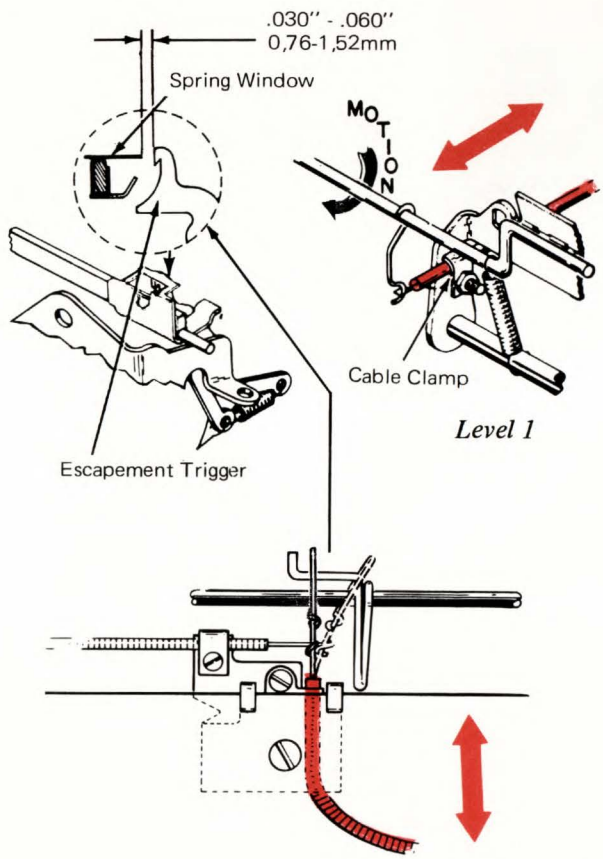
As the escapement trigger is pulled downward, it looses contact with the spring window and is pulled forward by a spring. As the escapement mechanism restores, the top of the trigger contacts the bottom of the spring window, pushes it up and is allowed to restore in its normal position over the escapement torque bar lug.

DEAD KEY MECHANISM ADJUSTMENTS

1. *Rear Cable Clamp* – Adjust the cable sheath under the clamp for .485' - .565" movement of the cable when a dead key position is operated.



2. *Front Cable Clamp* – Adjust the cable sheath under the clamp so that the escapement trigger is pulled .030" - .060" past the spring window.



DEAD KEY DISCONNECT MECHANISM THEORY

The purpose of the dead key disconnect is to disable the dead key mechanism and allow normal escapement for dead key positions. This is accomplished by a cable which pivots the dead key cable away from the finger on the dead key bail. The disconnect cable is controlled from the keyboard by a wheel mounted next to the tab set and clear lever. With the control wheel rotated away from the operator, the dead key mechanism operates normally. With the control wheel rotated toward the operator, the dead key mechanism is disconnected and escapement occurs for dead key positions. (Fig. 5)

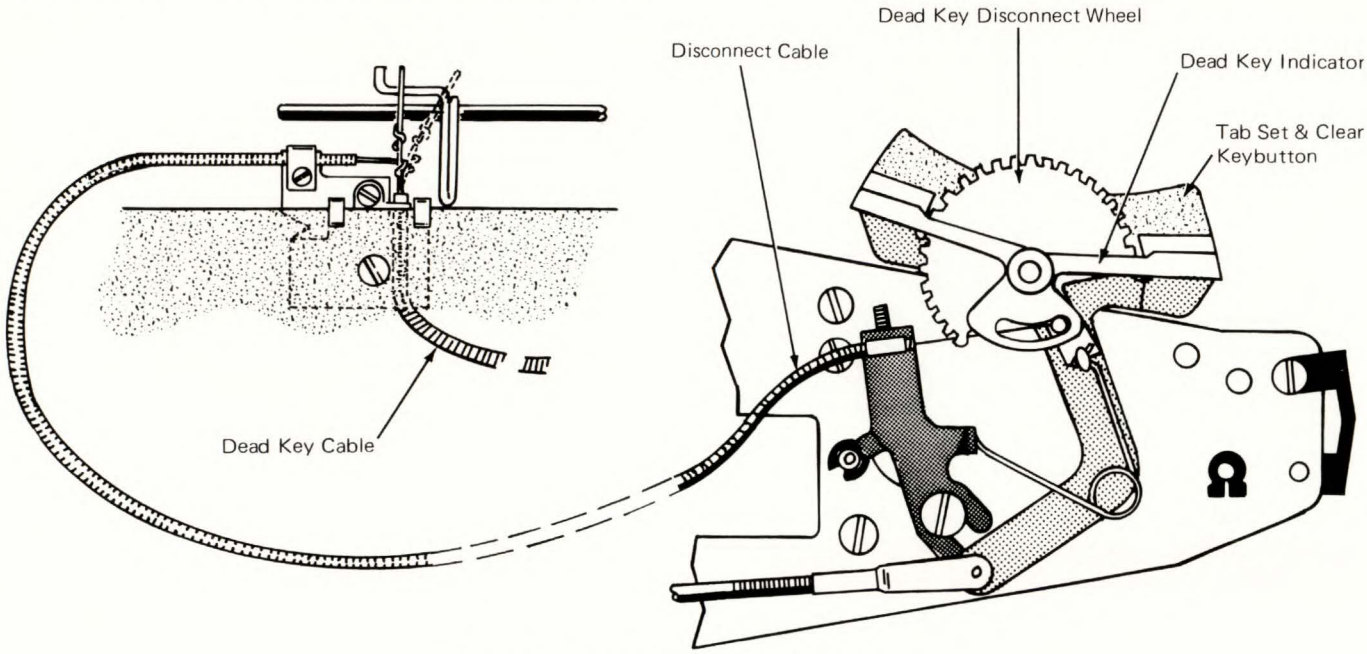
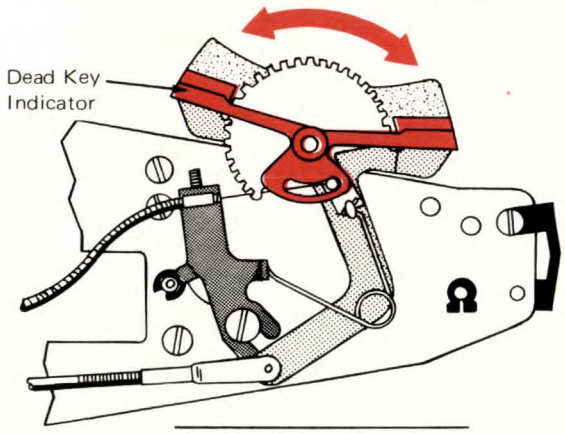


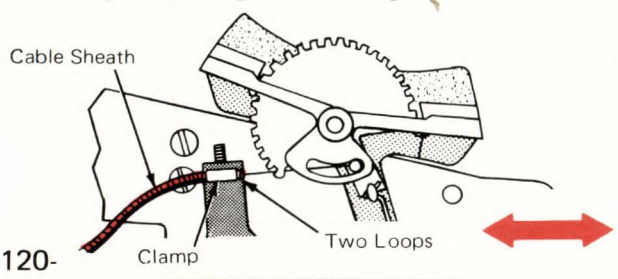
Figure 5 – Dead Key Disconnect Mechanism

DEAD KEY DISCONNECT MECHANISM ADJUSTMENTS

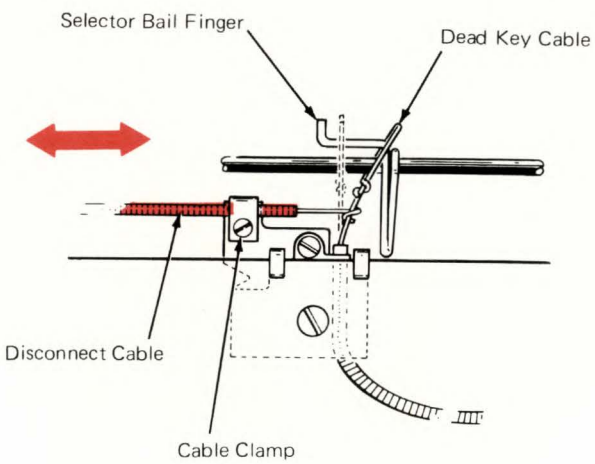
1. *Indicator* – Adjust the indicator to match the slope of the tab set and clear button.



2. *Front Cable Clamp* – Adjust the cable sheath so that the first two loops of the sheath extend beyond the edge of the clamp.



3. *Rear Cable Clamp* – With the control wheel rotated away from the operator, adjust the cable sheath left to right so that the dead key cable is centered on the dead key bail finger. With the control cable rotated toward the operator, the disconnect cable should push the dead key cable away from the working surface of the selector bail finger.



DOUBLE INDEXING DEVICE OPERATIONAL THEORY

The purpose of the double indexing device is to give double line spacing for each index position selected. When the index lever is set for single spacing, double line spacing occurs; and when the index lever is set for double spacing, quadruple line spacing occurs.

Double indexing is accomplished in the following manner. When the carrier return button is depressed, a normal operation of indexing and carrier return occurs. Motion from the carrier return latch through a bellcrank and a cable pulls the index keylever down. The index keylever is held down until carrier return has been completed, then a second index operation occurs. (Fig. 6)

For normal indexing, the index keylever may be used.

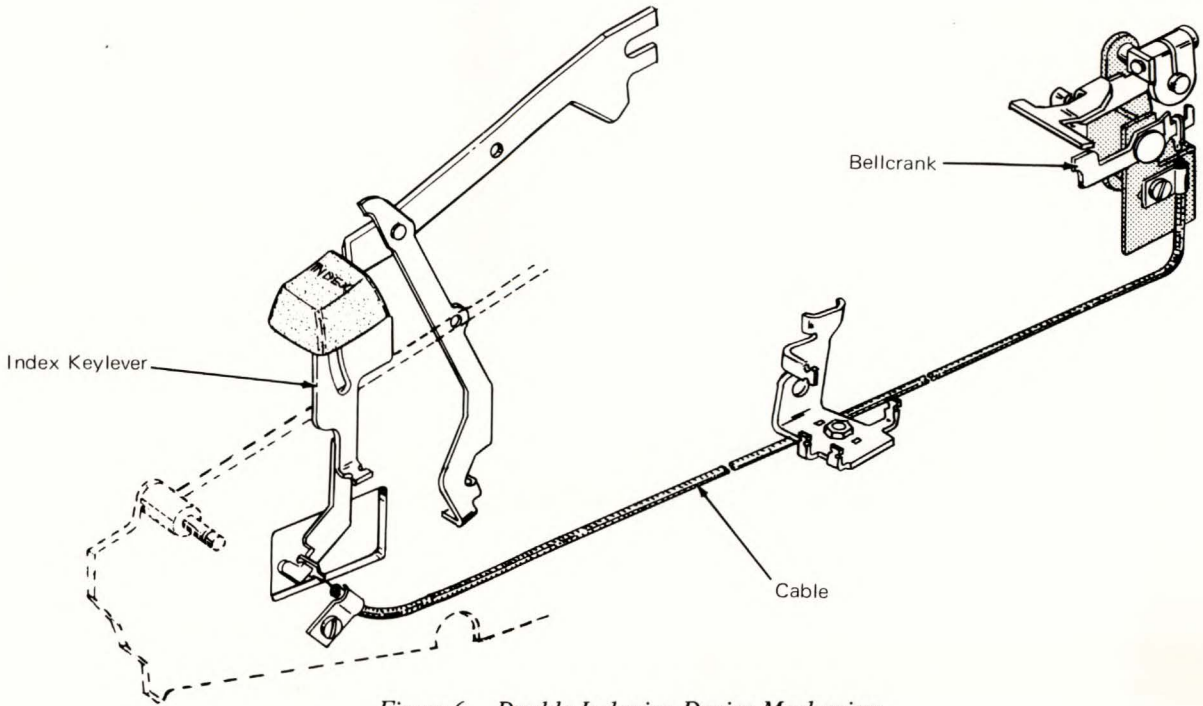
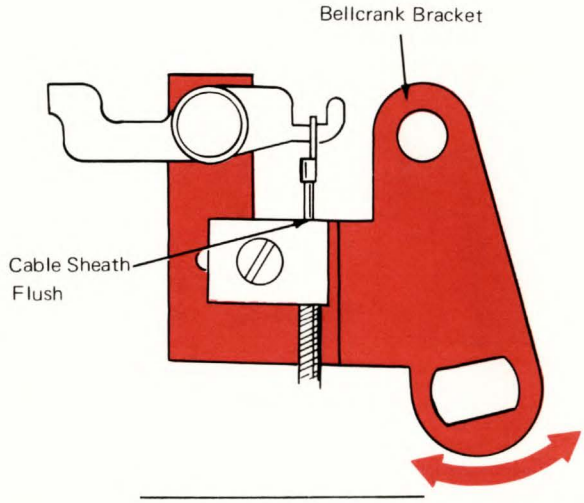


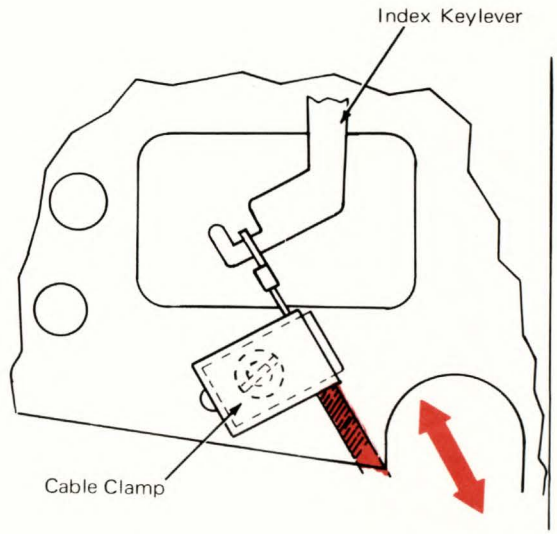
Figure 6 – Double Indexing Device Mechanism

DOUBLE INDEXING DEVICE ADJUSTMENTS

1. *Double Index Bellcrank* – Adjust the bellcrank bracket so the motion of the carrier return latch trips the index keylever without choking off the carrier return latch when the operational shaft is hand cycled.



2. *Side Frame Clamp* – Adjust the cable sheath under the side frame clamp so the index keylever does not choke off when depressed.



EXTERNAL RIBBON CONTROL OPERATIONAL THEORY

The external ribbon control is designed for customers with applications that require frequent changes of a bi-colored ribbon by allowing the operator to select stencil, black, or red ribbon positions without lifting the cover.

The control lever is located on the left side of the carrier. The operation and appearance is similar to the impression selector lever. (Fig. 7)

The ribbon control lever is mounted with the ribbon control bellcrank inside the left hand carrier casting. A wire link connects the control lever and the control bellcrank. When the control lever is moved front to rear, the control bellcrank pivots on its mounting stud. The control bellcrank causes the lift control lever to pivot. Connected to the lift control lever is the lift control link. The lift control link for the external ribbon control functions the same as the lift control link on the standard fabric ribbon mechanism.

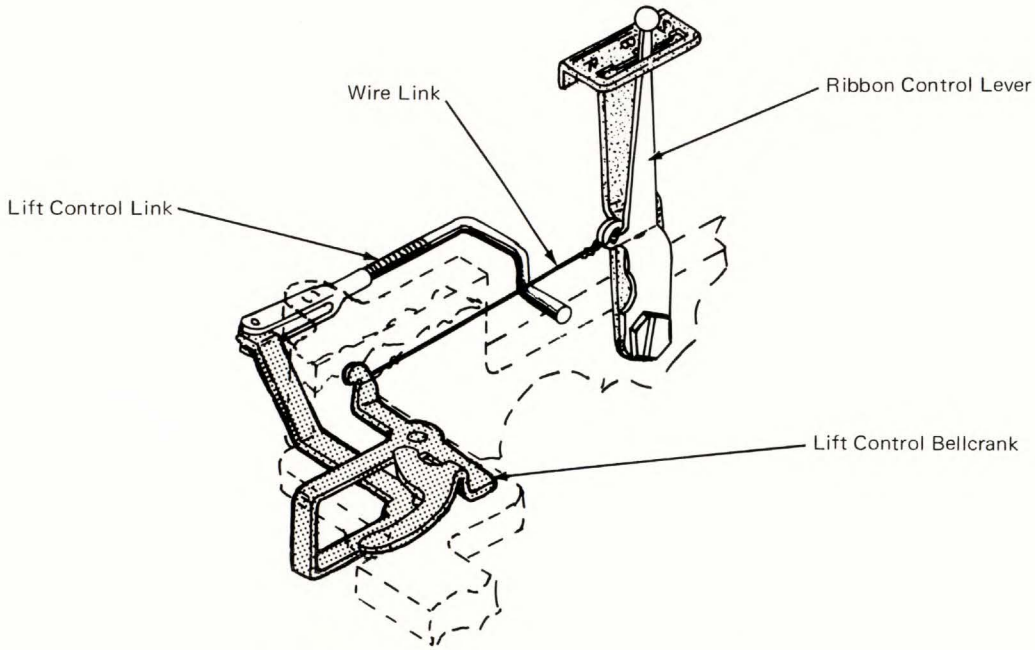
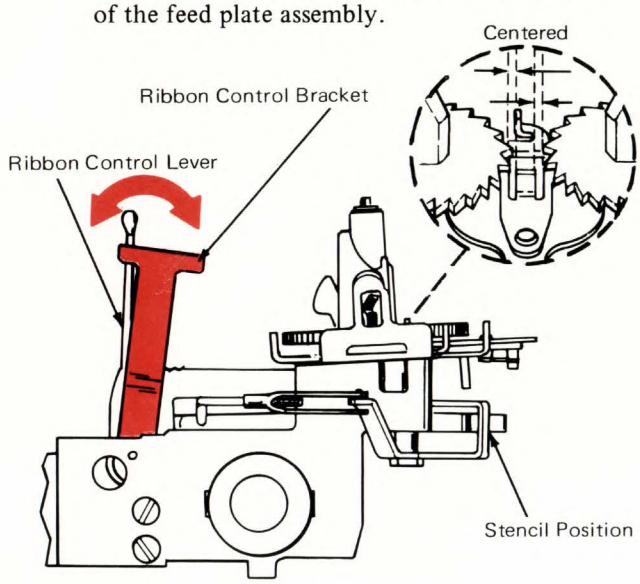


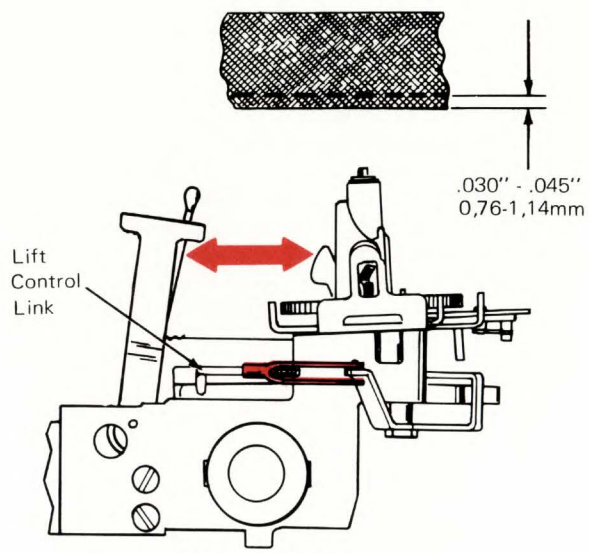
Figure 7 – External Ribbon Control Mechanism

EXTERNAL RIBBON CONTROL ADJUSTMENTS

1. *Ribbon Control Bracket* – With the control lever in the stencil position, adjust the control bracket so the ribbon feed pawl is centered between the two feed ratchets throughout the full movement of the feed plate assembly.



2. *Ribbon Lift Control Link* – With the ribbon control lever in the red position, adjust the control link clevis so the underscore will strike the ribbon .030" - .045" from the bottom edge.



High Lift Position

MANUAL VELOCITY CONTROL OPERATIONAL THEORY

The manual velocity control provides the operator with a means of controlling the automatic velocity control feature. A control wheel mounted just to the right of the on-off keybutton determines keyboard velocity. When the control wheel is in the middle or normal position, the keyboard is in the automatic velocity control mode. With the control wheel rotated away from the operator, all keyboard positions will be low velocity. The control wheel must be held in this position. When the control wheel is rotated toward the operator, the keyboard will be in high velocity. This position is detented and need not be held. (Fig. 8)

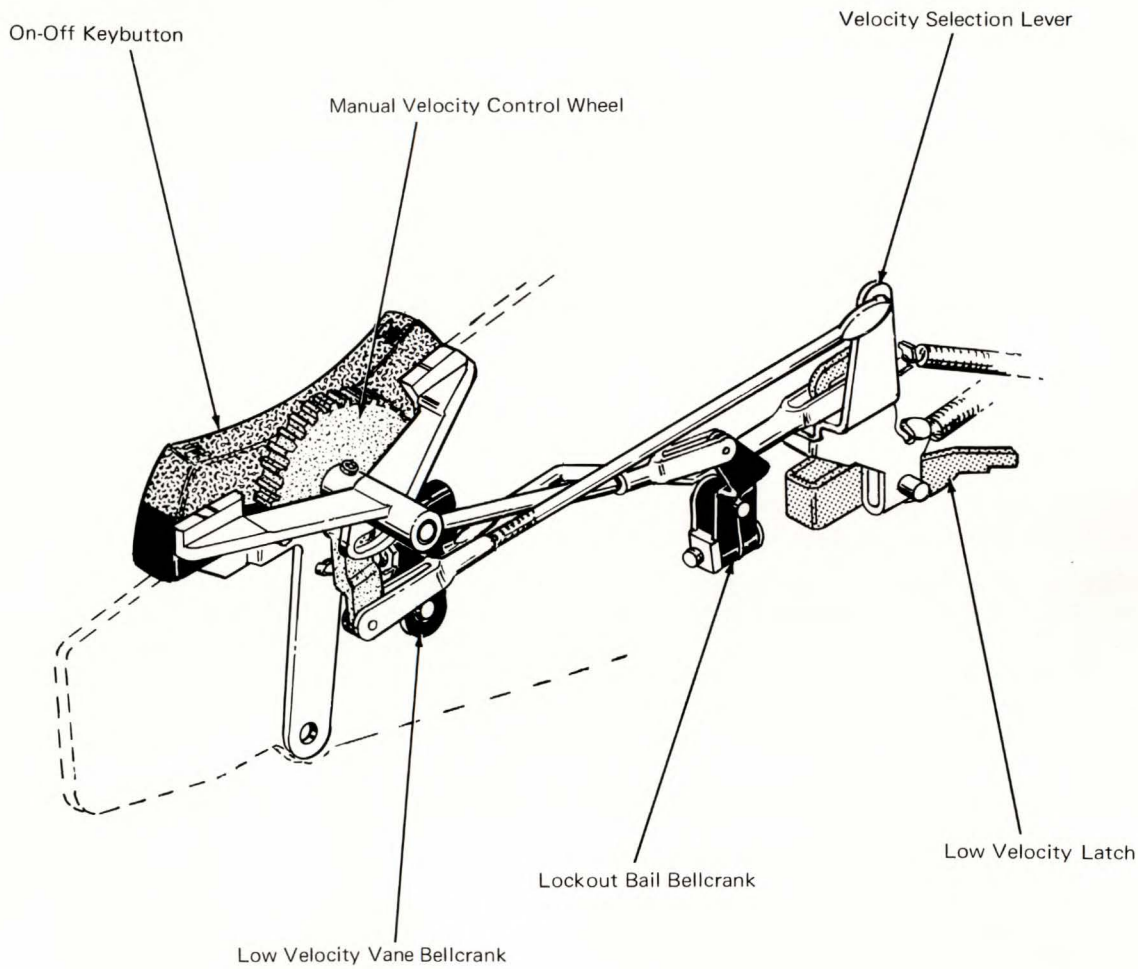


Figure 8 – Manual Velocity Control

The velocity selection lever is mounted to the right of, and on the same stud as, the low velocity latch. A link extends between the top of the velocity selection lever and a lower extension on the control wheel. (Fig. 9A) When the control wheel is rotated away from the operator, the link pulls the top of the velocity selection lever toward the front of the machine. A lug on the velocity selection lever contacts the low velocity latch and rotates it away from the low velocity cam follower stop. With the control wheel held in this position, the cam follower is allowed to provide low velocity from any keyboard position. (Fig. 9B)

When the control wheel is rotated toward the front of the machine, the top of the velocity selection lever is pushed toward the rear of the machine. Another lug on the velocity selection lever contacts the low velocity link and pushes it up out of the foot of the "L" slot. When an interposer operates the low velocity vane, the low velocity bellcrank will pull the link and the link will slide down the slot unable to move the latch. (Fig. 9C)

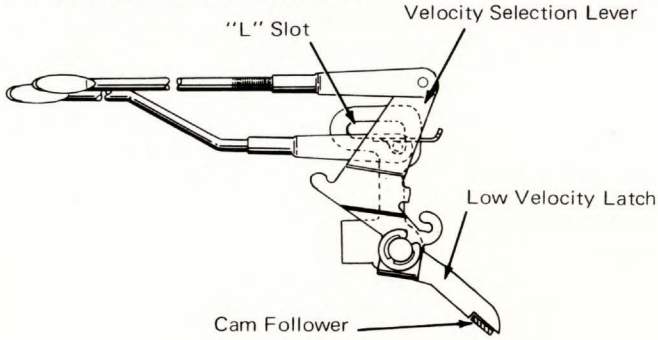


Figure 9A – At Rest

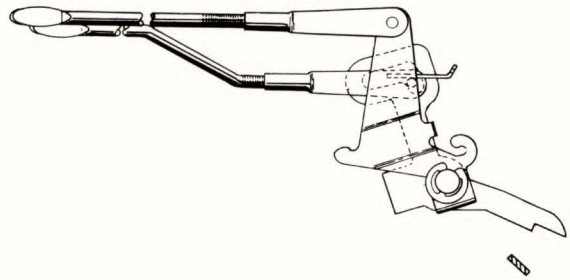


Figure 9B – All Low

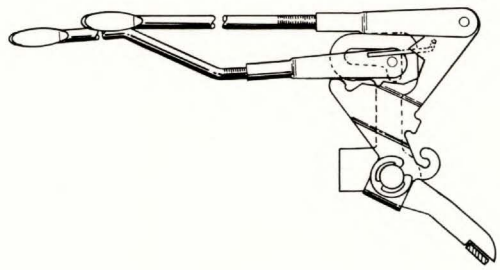


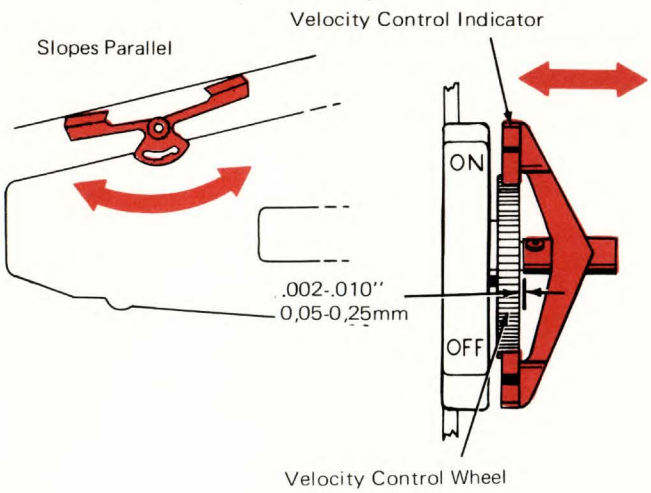
Figure 9C – All High

Figure 9 – Manual Velocity Selection

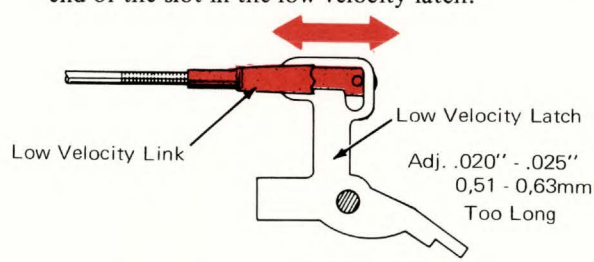
MANUAL VELOCITY CONTROL ADJUSTMENTS

1. *Velocity Control Indicator* – The indicator should be adjusted to satisfy two conditions.

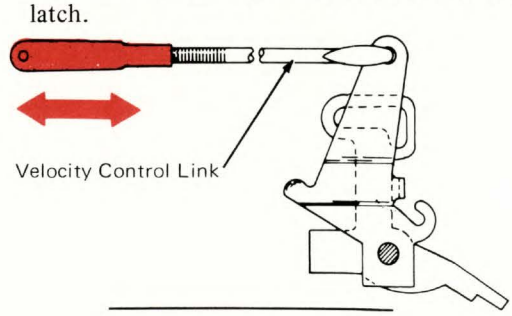
   a. Rotational – Adjust the indicator rotationally to match the slope of the keyboard.
   b. Lateral – Adjust the indicator left to right to maintain .002" - .010" end play of the velocity control indicator wheel.



2. *Low Velocity Link* – Disconnect the clevis from the low velocity latch. With the machine at rest and the low velocity vane against the tail of the interposers, adjust the clevis .020" - .025" past the end of the slot in the low velocity latch.



3. *Velocity Control Link* – Adjust the clevis so the control wheel will completely lift the low velocity latch link to the top of the slot in the velocity latch.



PIN FEED PLATEN OPERATIONAL THEORY

The purpose of the pin feed platen is to feed continuous forms. This is accomplished by two pin wheel assemblies, one on each end of the platen core. Platen cores come in lengths to accomodate most standard width forms.

The pin wheel body is setscrewed to a hexagonal shaft called the platen shaft. The platen core is keyed to the right hand pin wheel body. The platen ratchet is attached to the right end of the platen shaft. (Fig. 10)

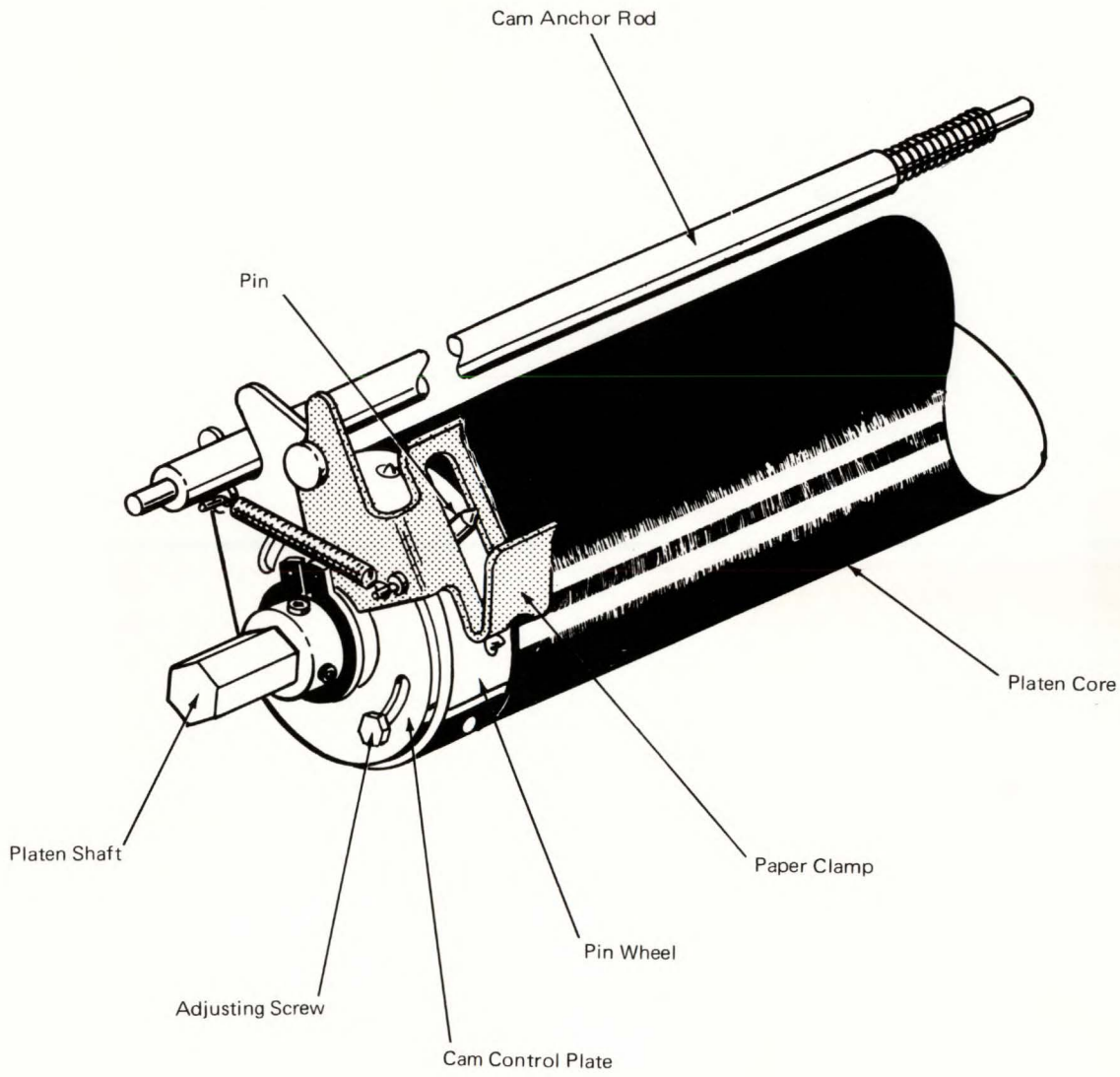


Figure 10 – Pin Feed Platen Assembly

Each pin wheel body has 9 holes, symmetrically spaced around its surface. In each hole is a pin (.140" diameter). A cam attached to the pin wheel body causes the pins to slide in and out of their holes. Screwed to the cam is a control plate which is anchored to the cam anchor rod. The cam is held stationary by the control plate while the pin wheel body rotates with the platen when indexed. This means that the pins will exit and enter the pin wheel body at an exact radial position thus providing the motion necessary to feed forms through the typewriter. (Fig. 11)

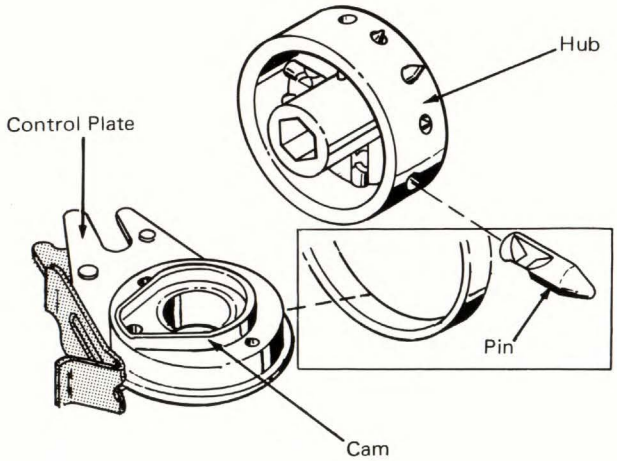
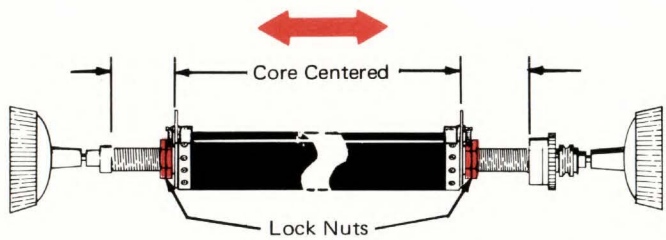


Figure 11 – Pin Wheel Assembly

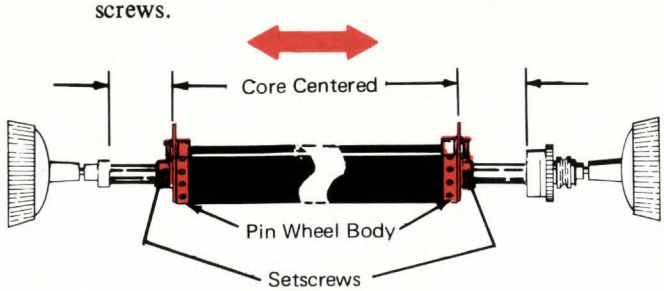
Level 1 pin feed platens have a threaded shaft and .125" diameter pins. Level 1 and Level 2 parts are not interchangeable. Both levels are exactly the same functionally.

PIN FEED PLATEN ADJUSTMENTS

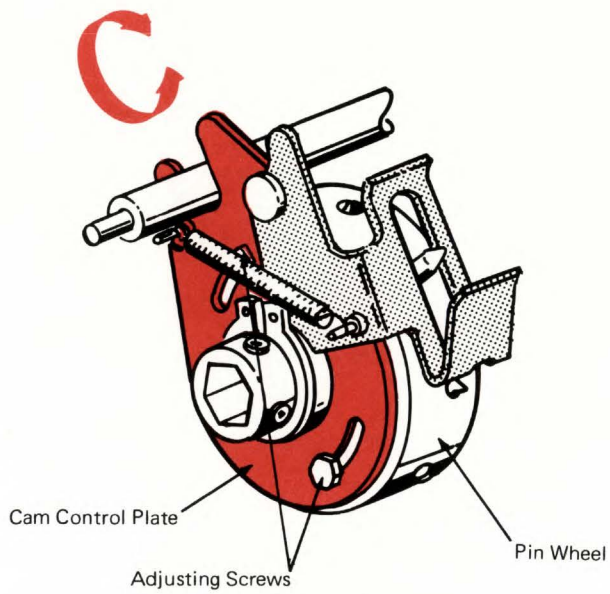
1. *Platen Core Lateral Position* – Level 1 – Loosen the lock nuts on both ends of the platen and center the core. Turn lock nuts in and tighten.



Level 2 – Loosen the setscrews in the pin wheel bodies. Center the core and slide the pin wheel assemblies up against each end. Tighten the setscrews.



2. *Pin Wheel Assembly* – Adjust the cam control plate so the pins are fully extended immediately after passing into the slot of the form guide.



SHIFT SENSING MECHANISM OPERATIONAL THEORY

The purpose of the shift sensing mechanism is to move the low velocity vane to the left when the machine is in the upper case mode. This allows certain predetermined keyboard positions that are low velocity in lower case, to be high velocity in upper case. This is used on keyboards with the ten key numeric in-set such as the 056 and 065 OCR keyboards where the numerals 8 and 9 are above the comma and period. (Fig. 12)

With the machine in lower case, the low velocity vane is held to the right by a flat spring. The vane actuating bellcrank is mounted to the rear of the vane and held against its spring tension in a counterclockwise position by the shift sensing cable. The other end of the cable is mounted to a plate on the rear of the shift arm. When the machine is shifted to upper case, tension on the sensing cable is relaxed and the bellcrank spring rotates the bellcrank clockwise. As the bellcrank rotates, it pushes the low velocity vane to the left. This allows certain interposers which have low velocity in lower case to now have high velocity in upper case because the lugs on the low velocity vane are not in front of the interposers.

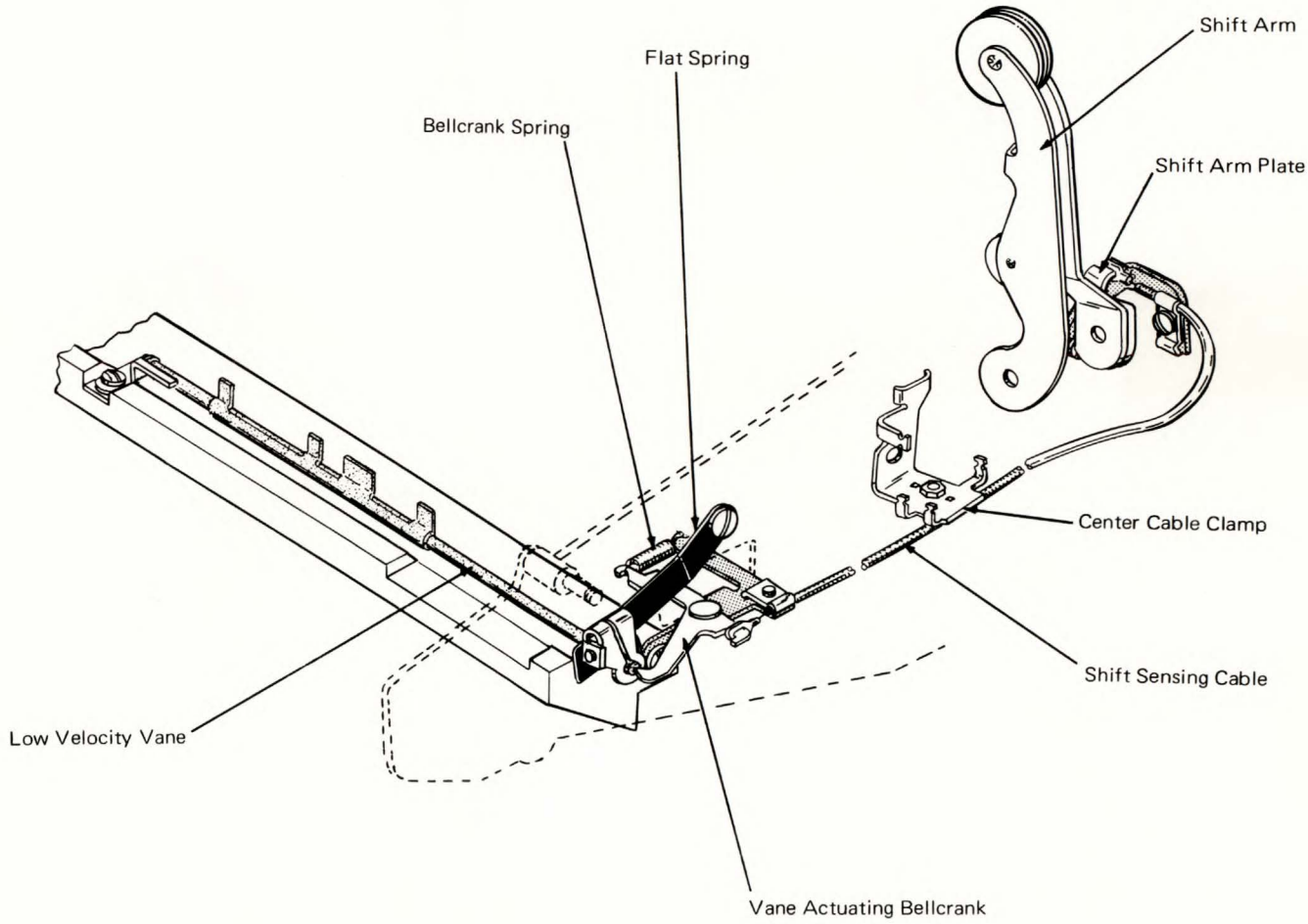
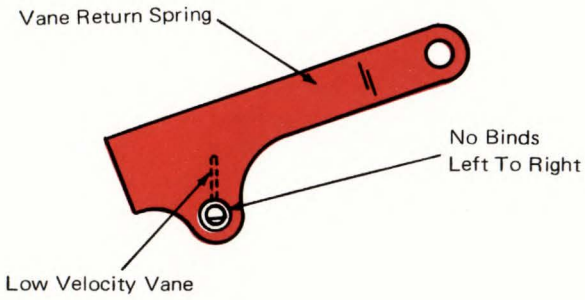


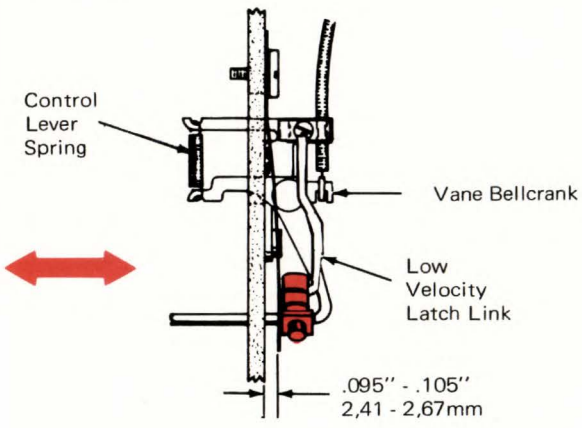
Figure 12 – Shift Sensing Mechanism

SHIFT SENSING MECHANISM ADJUSTMENTS

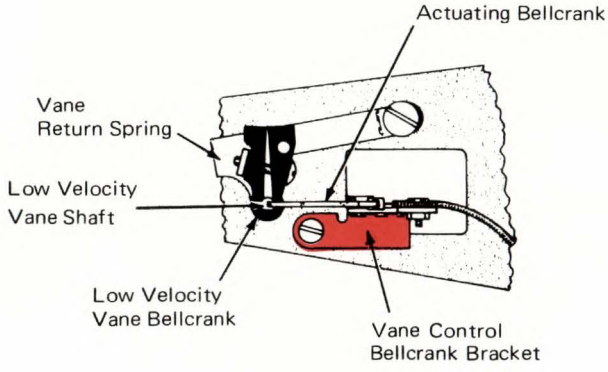
1. *Vane Return Spring* – Ensure that the low velocity vane does not bind off on the vane return spring.



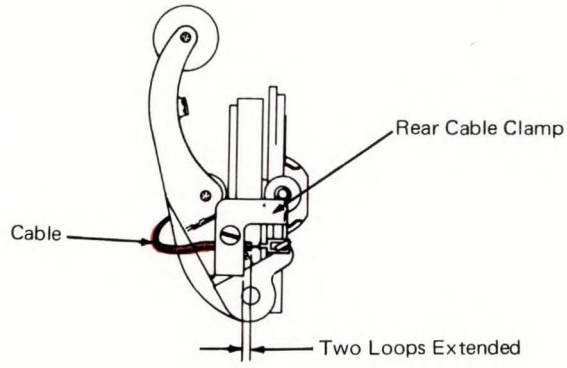
2. *Vane Bellcrank* – Adjust the bellcrank left to right so the vane moves .095" - .105" to the left when actuated.



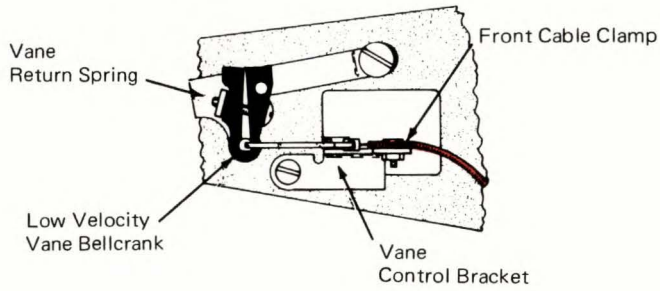
3. *Actuating Bellcrank Bracket* – Adjust the bellcrank bracket so the actuating tip travels in the center line of the low velocity vane shaft.



4. *Rear Cable Clamp* – Adjust the sheath under the rear cable clamp so the sheath extends two loops from the clamp bracket.

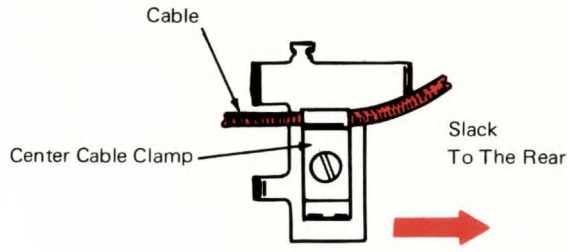


5. *Front Cable Clamp* – Adjust the sheath under the clamp so the front cable anchor does not restrain the actuating bellcrank when the machine is in upper case.



6. *Center Cable Clamp* – Adjust the sheath under the clamp so most of the slack is to the rear of the clamp.

NOTE: When adjusting either of the three cable clamps, care should be taken to ensure that the cable does not kink in either the rest or the activated position. There should be adequate room at either end of the sheath for free motion of the cable and the sheath should not interfere with adjoining links or mechanisms.



STROKE COUNTER OPERATIONAL THEORY

The purpose of the stroke counter is to record actual usage of the "Selectric" Typewriter. This is accomplished by a non-resetting mechanical counter mounted inside the power frame above the left hand cam of the cycle shaft assembly. (Fig. 13)

The stroke counter arm is spring loaded against the cam and moves up and down with the camming surface each time the cycle shaft operates. The left hand dust shield has a portion removed to allow the counter to be read.

Stroke counters for the "Selectric" Typewriter are available with a 10:1, 100:1, or 240:1 ratio. This means that for every 100 print operations, the 100:1 ratio counter will advance 1, etc.

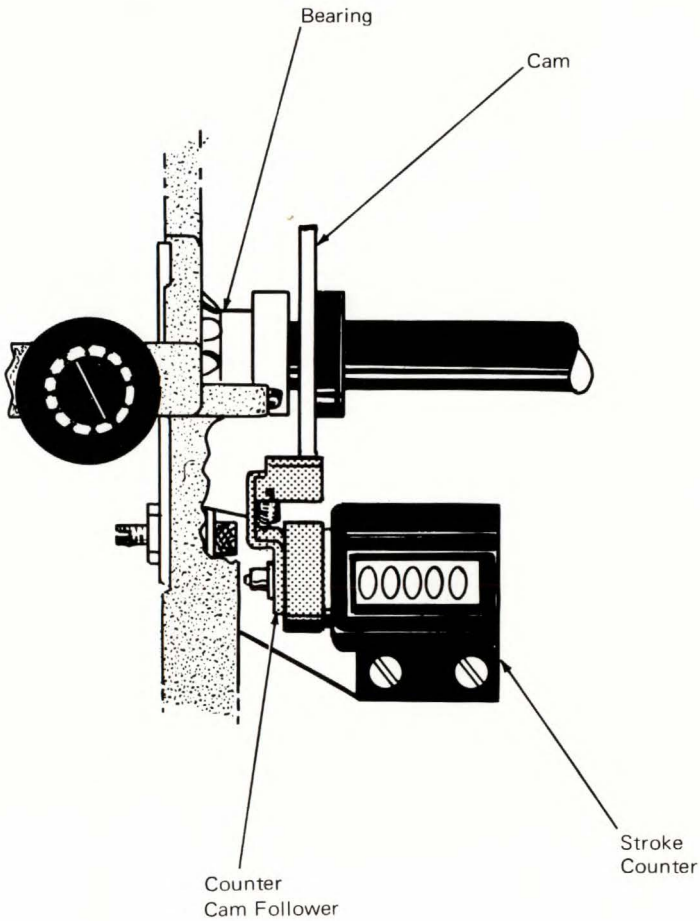


Figure 13 – Stroke Counter Mounting

There are no adjustments for the stroke counter.

COVER REMOVAL
(Mech. Code 704)

Level 1 & 2

1. Position the carrier near the center.
2. Move the margin stops away from the carrier.
3. Tip the machine on its back.
4. If level 1 cover, loosen cover screw at center rear.
5. Pry rear of cover straight away from machine.
6. a. If level 1 cover, lift bottom cover vertically to free front brackets.
   b. If level 2 cover, pry front of bottom cover straight away from machine.
7. Remove the power cord from the rear vent grille.
8. Loosen the four mounting screws that secure the mounting plates to the center cover.
9. Set the machine on its feet, then pivot the locking plates from beneath the mounting screws.
10. Pull the paper release lever and paper bail forward.
11. If the machine is equipped with a paper table, pivot the paper table to the rear.
12. Raise the top cover and remove the platen by releasing the latch at each end.
13. Latch both margin levers and the red pointer up.
14. Remove the top and center cover by lifting straight up.
15. Reinstall platen.

Level 3

1. Position the carrier near the center.
2. Move the margin stops away from the carrier.
3. Pull the paper release lever and the paper bail forward.
4. Raise the top cover and pivot the paper table to the rear.
5. Remove the platen by releasing the latch at each end.
6. Pull the cover release levers (inside center cover section) forward.
7. Latch both margin levers and the red pointer up.
8. Lift the top and center cover straight up.
9. Remove the plastic vent grille by lifting straight up.
10. Reinstall platen.
11. Pull bottom cover release lever forward.
12. Machine may now be tilted up within the bottom cover.

TILT RING AND ROTATE SHAFT REMOVAL
(Mech. Code 702, 704)

1. Remove the dust cover and ribbon.
2. Center the carrier over the cycle shaft.
3. Shift the machine to upper case.
4. Half cycle a zero rotate, tilt 1 character.
5. Remove the c-clip and disconnect the tilt pulley link. (gearless tilt mechanism only)
6. Loosen the tilt ring pivot pin setscrews.
7. Remove the two pivot pins.
8. Remove the tilt ring and dog bone.
9. Loosen the rotate pulley setscrew.
10. Use the butt end of the small spring hook as a follower to push out the rotate shaft. This prevents the wedge from being lost. When replacing the shaft, be sure the pin is pointing toward the front-left and right-rear corners.
11. The following adjustments should be checked after the rotate shaft and tilt ring are replaced:
    a. Tilt detent
    b. Typehead homing
    c. Tilt ring
    d. Upper ball socket

CARRIER AND ROCKER ASSEMBLY REMOVAL
(Mech. Code 702, 703, 706, 712, 718, 722, 723)

1. Remove the platen, deflector and feed rolls.
2. Remove the card holder and brackets.
3. Remove the tilt tape.
4. Release the rotate spring tension and remove the rotate tape.
5. Disconnect the carrier return and escapement/tab cords from the carrier.
6. Disconnect the velocity cable from the carrier.
7. Remove the escapement bracket screws and work the carrier out from beneath the escapement bracket.
8. Remove the print shaft.
   a. Level 1 print shafts are removed by removing the print shaft gear and sliding the print shaft out through the right bearing.
   b. Level 2 print shafts are removed by removing the c-clip to the right of the left bearing and sliding the print shaft out through the left bearing.
9. The carrier assembly may now be lifted from the machine.

ROCKER ASSEMBLY REMOVAL
(Mech. Code 702, 713, 714, 722, 723)

1. Remove the ribbon mechanism.
2. Remove the cardholder brackets.
3. Slowly release the rotate spring tension.
4. Disconnect the rotate tape.
5. Disconnect the tilt tape.
6. Remove the gearless tilt pulley.
7. Remove the tape guide.
8. Remove the striker if present.
9. Remove the rotate spring.
10. Remove the rotate pulley.
11. Remove the impression control or velocity plate.
12. Loosen the rocker shaft setscrew.
13. Remove the c-clip from the right side of the rocker shaft.
14. Remove the rocker shaft.
15. The rocker assembly may now be removed from the carrier.

ROTATE SPRING REPLACEMENT
(Mech. Code 702, 704)

Gear Tilt

1. Remove the left dust cover.
2. Remove the ribbon.
3. Center the carrier over the cycle shaft.
4. Gradually remove the tension from the rotate spring. Remove the two nuts, one on newer machine, immediately to the right of the yoke on the carrier, remove the black rotate spring tension clip from under the nut.
5. a. On older machines, back out the two screws on the right 1/4" and remove the screw on the left, which is under the cycle shaft.
   b. On newer machines, remove the lower right and left screws and back out the upper right screw 1/4".
6. Remove the striker and rotate spring retaining plate. The rotate spring can now be removed. **Note:** In newer machines there may be a spring clip (P/N 1141238) that prevents the spring from being trapped in the pulley notch. If not, one should be added on reassembly.
7. The following adjustments should be checked after the rotate spring is replaced:
   a. Rotate spring tension.
   b. Typehead homing.
   c. Damper spring (if used)

Gearless Tilt

1. Remove the left dust shield.
2. Center the carrier over the cycle shaft.
3. Remove the tension from the rotate spring gradually.
4. Remove the screws from the rotate spring retaining plate.
5. Remove the rotate spring retaining plate. The rotate spring may now be removed.
6. The following adjustments should be checked after the rotate spring is replaced:
   a. Rotate spring tension.
   b. Typehead homing.
   c. Damper spring (if used).

OPERATIONAL SHAFT REMOVAL
(Mech. Code 703, 716, 718)

1. Remove the c-clip from the right end of the operational shaft and remove the shift clutch ratchet.
2. Remove the shift clutch spring.
3. Loosen the torque limiter hub.
4. Loosen the tab governor collars.
5. Loosen the operational cam ratchet.
6. (7X3-7X5) Loosen the collar at the right side of the operational shaft.
7. Install the hand cycle tool.
8. Pull the operational shaft slightly to the right and remove the c-clip(s) from the carrier return pinion.
9. The operational shaft may now be pulled to the right.

PRINT SLEEVE REMOVAL
(Mech. Code 702, 713, 714)

1. Center the carrier.
2. Remove the ribbon mechanism.
3. Remove the print shaft.
   a. Level 1 print shafts are removed by removing the print shaft gear and sliding the print shaft out through the right bearing.
   b. Level 2 print shafts are removed by removing the c-clip to the right side of the left bearing and sliding the print shaft out through the left bearing.
4. Remove the left print shaft wiper retainer.
5. Loosen the ribbon lift cam.
6. Loosen the ribbon feed and detent cam.
7. Loosen the print cam.
8. Slide the ribbon feed and detent cam to the right against the print cam.
9. Slide the ribbon lift cam to the right and onto the print shaft key.
10. Slide the print sleeve to the left.
11. Remove the print cam.
12. Remove the ribbon feed and detent cam.
13. Slide the print sleeve to the right.
14. Slide the ribbon lift cam to the left.
15. Remove the print shaft key.
16. Pull the print sleeve out through the left carrier bearing while sliding the ribbon lift cam off.
17. The following adjustments should be checked after replacing the print sleeve:
    a. Print sleeve end play.
    b. Detent skirt clearance.
    c. Print shaft timing.
    d. Ribbon plate.

ESCAPEMENT PAWL REMOVAL
(Mech. Code 701, 702, 706, 712, 722)

1. Remove the platen.
2. Remove the deflector and feed rolls.
3. Position the carrier near the left margin.
4. Remove the nut from the escapement pawl mounting stud.
5. Remove the escapement pawl mounting stud.
6. Remove the escapement pawl and backspace pawl.
7. Installation of the escapement and backspace pawls and spacer will be much easier if the two pawls and spacer are assembled and retained with a rubber band. Then the three parts can be installed as a single unit and the rubber band cut away.
8. The following adjustments should be checked after the escapement pawl is replaced:
   a. Escapement torque bar stop.
   b. Pawl mounting stud.
   c. Torque bar backstop.
   d. Carrier return pawl clearance.
   e. Tab pawl clearance.
   f. Backspace rack.
   g. Backspace motion.

CYCLE CLUTCH AND CYCLE SHAFT REMOVAL (Mech. Code 702, 704, 721, 723)

1. Position the carrier to the extreme right.
2. Remove the left dust cover.
3. Remove the gear guard.
4. Remove the cycle clutch check pawl and spring.
5. Remove the lower idler gear.
6. Remove the three bearing plate screws.
7. Loosen the bearing plate from the frame by prying it away from the frame (front first) with a screwdriver.
8. Remove the positive bail spring.
9. Force the positive bail down with a screwdriver and remove all latches from beneath the bail.
10. Remove the cycle shaft, pushing the Negative 5 and Rotate 2 links out of the way with the pusher end of a spring hook.
11. Remove the shims from the old shaft and put them on the new one. Check to see that proper end play (.001"-.006") is present. Reshim if necessary.
12. The following adjustments should be checked after the cycle shaft is replaced:
    a. Idler gears.
    b. Cycle shaft end play.
    c. Cycle clutch spring.
    d. Cycle clutch latch bite.
    e. Damper spring (if used).
    f. Filter shaft timing.
    g. Print shaft timing.

DRIVE BELT REMOVAL (Mech. Code 702, 704, 711, 721, 723)

1. Position the carrier to the extreme right.
2. Remove the left dust cover.
3. Remove the gear guard.
4. Remove the cycle clutch check pawl and spring.
5. Remove the lower idler gear.
6. Remove the three bearing plate screws.
7. Loosen the bearing plate from the frame by prying it away from the frame (front first) with a screwdriver.
8. Remove the positive bail spring.
9. Force the positive bail down with a screwdriver and remove all latches from beneath the bail.
10. Remove the cycle shaft, pushing the Negative 5 and Rotate 2 links out of the way with the pusher end of a spring hook.
11. Remove the drive belt.
12. The following adjustments should be checked after the drive belt is replaced:
    a. Idler gears.
    b. Cycle clutch spring.
    c. Filter shaft timing.
    d. Print shaft timing.
    e. Drive belt tension.

ROTATE SELECTION DIFFERENTIAL REMOVAL (Mech. Code 702, 704, 711, 721, 723)

1. Position the carrier to the extreme right.
2. Remove the left dust cover, platen, feed rolls, and paper deflector.
3. Remove the machine from the bottom pan.
4. Disconnect the clevises and remove them from the selector latch links.
5. Remove the latch bail spring.
6. Remove the motor.
7. Remove the rotate latch springs.
8. Pull out the rotate links.
9. Disconnect the tilt differential spring.
10. Remove the upper guide bracket screws.
11. Remove the balance arm mounting stud.
12. Disconnect the minus five bail drive link from the right end of the balance arm.
13. Rotate the cycle shaft until the cam followers are on the low points of the cams.
14. Remove the rotate differential assembly.
15. The following adjustments should be checked after the rotate selection differential assembly is replaced:
    a. Typehead homing.
    b. Rotate latch clearance.
    c. Rotate differential guides.
    d. Selector latch links.

KEYBOARD INTERPOSER REMOVAL (Mech. Code 702, 709, 717, 721)

1. Align the carrier over the line lock interposer.
2. Disconnect the operational keylever springs and repeat bail spring.
3. Remove keylever upstop.
4. Remove the spacebar equalizing rod.
5. Remove the bell bail lever.
6. Remove the bell ringer bail.
7. Remove the margin rack.
8. Slip sound deadening over operational keybuttons and pivot the keyboard up and out of the way.
9. Push the fulcrum rod to the interposer being removed with a fulcrum rod tool.
10. Remove the spring from the interposer being removed.

SHIFT CAM REMOVAL (Mech. Code 702, 716, 723)

1. Turn the typehead counterclockwise and remove the relaxed rotate tape from the shift arm pulley and put it around the tilt pulley. **Note**: On one piece shift arm the rotate tape must be disconnected from the right side of the carrier.
2. Remove the shift interlock spring, the shift release arm spring and the shift detent spring.
3. Remove the c-clip from the operational shaft and remove the shift clutch ratchet .

7X1

4. Remove the interlock.
5. Remove the detent arm.
6. Disconnect the shift release link.
7. Remove the shift release arm.

7X3-7X5

4. Disconnect the shift release link.
5. Remove the shift support bracket screw.
6. Remove the shift support bracket, interlock and shift release lever as an assembly.
7. Remove the detent arm.

All

8. Remove the shift clutch spring (behind the ratchet). **Note**: Observe the spring position for replacement.
9. Remove the shift clutch arbor.
10. Remove the shift cam.

CORD REPLACEMENT
(Mech. Code 703, 718)

1. Carrier centered – remove both cords if one is frayed or broken.
2. Turn front drum slot upwards; attach the escapement cord to the drum and thread out through the side frame.
3. Hold the metal anchor with scissor clamps or spring hook, and wind the cord onto the drum (turning by hand) until the anchor is drawn to the side frame.
4. Hook a new return cord to the carrier, thread through and attach to the rear drum. Disregard the slack.
5. Now, with the clamps or spring hook, pull the escapement cord around the tension pulley and hook it to the carrier. This will wind up the return cord.
6. Recheck mainspring tension; this may have decreased while turning the shafts with the cords disconnected.
7. Check for correct position of the RH cord tension pulley. Also check for correct position of the tension pulley bracket (new-style) to prevent accidental and premature fraying of cords on the power frame or on the pulley flanges.

ROTATE TAPE REPLACEMENT
(Mech. Code 702, 723)

1. Half cycle the machine with the typehead on.
2. Manually withdraw the rotate detent and use the typehead to wind the rotate spring approximately 3-1/2 turns or until the slot for the tape is accessible at near 3-1/2 turns.
3. Allow the rotate detent to re-enter. It will hold the position of the head and rotate pulley.
4. Insert the tape anchor into the pulley and thread the eye end through the rotate arm, shift arm, and on to the anchor in the right of the carrier.
5. Allow the shift arm to drop down and take up slack in the tape.
6. Hold the typehead and manually withdraw the detents. Control the type element to allow the rotate spring to slowly wind the tape as you guide it correctly around each of its pulleys.
7. Half cycle the machine to a lower case "m" and check rotate spring tension. Check homing and other adjustments as necessary.

LUBRICATION

The "Selectric" Typewriter will not operate dependably and reliably if it is not thoroughly and properly lubricated.

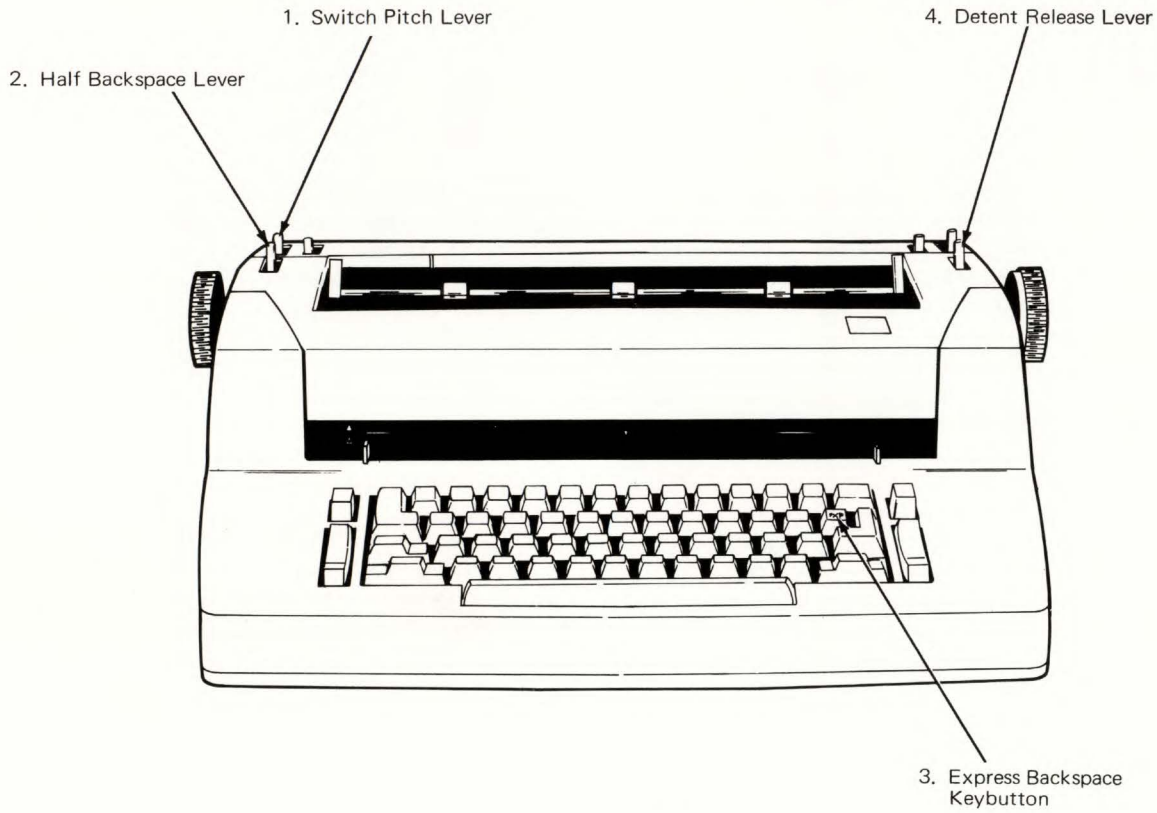
Use IBM No. 10 oil on the following:

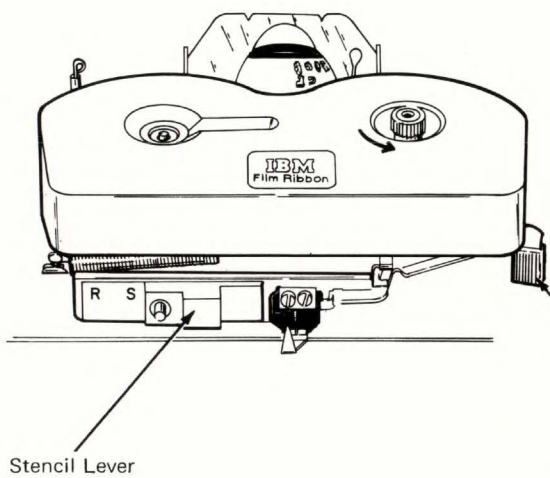
a. Print Shaft Wipers
b. Cycle Shaft Bearing
c. Margin rack bearing
d. Margin stops
e. Carrier shoe
f. Rotate detent guide, upper and lower ball sockets, tilt detent pivots
g. Motor
h. Selection bail rollers
i. Index pawl assembly
j. All power operated links and clevises at both ends
k. Ribbon feed and reverse plate
l. B/S intermediate lever
m. Differential assemblies
n. All functional parts and pivots in operational box assembly
o. Tilt arm pivot and rotate link stud
p. Rotate arm pivot and rotate link pivot studs
q. Carbon ribbon drive spring and bearing
r. Power frame center bearing
s. Platen bushings
t. All other rotating or pivoting members at the bearing area which are not specifically excepted in the listing following.

Use IBM No. 23 grease on the following:

a. Operation ratchets
b. Keylever return springs
c. Interposer latch springs
d. Ribbon lift control lever
e. Line lock bracket
f. Filter shaft flutes
g. Operational keylever pawl guide studs
h. Tape guide
i. All cams on print sleeve
j. Ball joint
k. Cycle clutch and shift clutch springs
l. Feed roll bearing
m. Cycle clutch restoring cam
n. Low velocity latch contacts
o. All sliding parts not excepted

The functional check for the "Selectric" Typewriter is in the "Selectric" Typewriter Service Manual. This functional check is only for the new mechanisms in the Dual Pitch "Selectric" II Typewriter.





OPERATOR CONTROLS

1. *Switch Pitch Lever* – The switch pitch lever changes the pitch of the machine between the 10 pitch mode and the 12 pitch mode.
2. *Half Backspace Lever* – The half backspace lever moves the carrier one half space to the left when the lever is held forward.
3. *Express Backspace Keybutton* – The express backspace keybutton moves the carrier rapidly to the left as long as the keybutton is held depressed.
4. *Detent Release Lever* – This control performs the same function as on the "Selectric" Typewriter; just its location is changed.
5. *Stencil Lever* – The stencil lever slides right to left and determines whether the ribbon mechanism is in the ribbon or stencil mode.
6. *Ribbon Load Lever* – The ribbon load lever raises the ribbon lift guides and prepares the ribbon mechanism to permit changing the ribbon.

SWITCH PITCH/HALF BACKSPACE

A. Place your switch pitch lever in the 10 pitch mode (to the rear). With the margin set at 0, carrier return and make a strike-up of letter "l's" about two inches long.
B. Pull the switch pitch lever forward to the 12 pitch mode. Carrier return and make another strike-up below the previous one. The machine changed pitch if the second row of characters do not align with the first row.
C. Return the machine to its 10 pitch mode and type a series of slashes(/). Backspace to the beginning of the slashes; then pull the half backspace lever forward.
D. While holding the lever forward, type another series of slashes. The characters must be centered between the characters previously typed.

DUAL PITCH TAB/ESCAPEMENT

A. Install a sheet of paper. Clear all tab stops and reset tabs at several locations along the writing line. Operate the tab from the margin and type a character at each stop. Repeat this procedure for three lines. The characters should line up in straight vertical columns.

   Clear the tab stops and change pitch. Make the same check again after changing pitches.
B. Now, tab all the way to the right. Hold down the tab clear keybutton and operate the carrier return. All the set tab stops should clear automatically without excessive noise.
C. With the carrier at the extreme right, depress the carrier return, then depress the tab. The tab operation should immediately override the carrier return.
D. With the carrier at the extreme left and all tab stops cleared, depress the tab, then the carrier return. The carrier return should immediately override the tab.

ROTARY BACKSPACE/EXPRESS BACKSPACE

A. Turn the paper in your machine sideways; then starting with the carrier at the left, type a row of "h's" and "n's" alternately for a total of ten characters. Now, backspace 10 spaces and type over. The characters should overlay each other. Make the check in both pitches.
B. Also check the backspace in a similar manner with the carrier positioned in the middle and towards the right of the writing line.
C. Check to see that the backspace mechanism repeats when slight additional pressure is applied to the keybutton.
D. Depress the express backspace keybutton. The carrier should move to the left as long as the keybutton is held depressed.

SELECTIVE RIBBON SYSTEM

A. Put a single sheet of bond paper in your machine. With the multiple copy control lever forward and the impression control lever on three, make a complete strike-up in upper and lower case.
B. Inspect the copy for character uniformity; that is, even color density throughout.
C. Inspect the copy for ribbon flaking; that is, splattering of ribbon particles on the copy.
D. With a film ribbon installed on your machine, the lift pattern should look like this example:

   Inspect the ribbon pattern on your machine. The characters should not overlap one another and the characters should be positioned on the ribbon with a margin of safety at the top and bottom.

   With a Tech III ribbon installed on your machine, inspect the ribbon pattern. The characters should overlap one another and there should be a margin of safety at the top and bottom of the ribbon. Type several lines of underscores. The typing must not fade.
E. Inspect the ribbon throughout its path around the various guides and rollers. There should be no creases in the ribbon.
F. Finally, place the stencil control lever in the stencil position and type several characters. The ribbon should not feed or lift.

The purpose of the switch pitch mechanism is to perform the necessary switching operations within the escapement and margin mechanisms to allow the dual pitch "Selectric" II Typewriter to function properly in either 10 or 12 pitch. Both the escapement rack and margin rack are rods with teeth cut into two sides. Ten pitch teeth and 12 pitch teeth are cut into opposing sides of the racks. The racks are retained in cutouts in the escapement and margin rails. This puts the escapement rack teeth and the margin rack teeth in approximately the same position in the machine as the single pitch escapement and margin rack teeth. Both the margin and escapement mechanisms function in the same manner as the single pitch "Selectric" Typewriter. Therefore, in order to switch pitch it is only necessary to rotate the racks until either the 10 pitch teeth or 12 pitch teeth face the rear of the machine and engage the escapement pawl and margin slider. (Fig. 1)

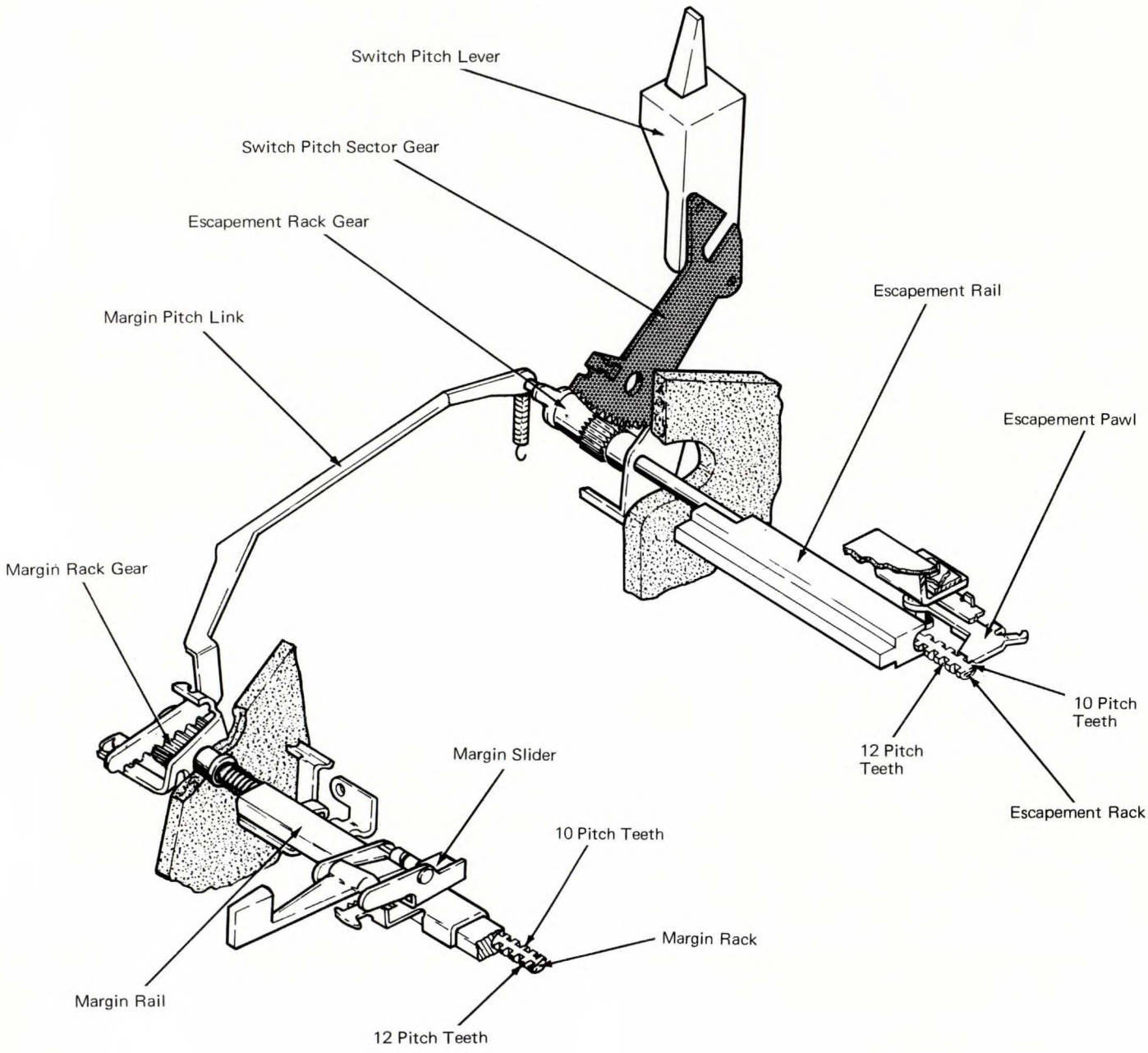


Figure 1 – Switch Pitch Mechanism

ESCAPEMENT RACK ROTATION

The escapement rail is screwed to the power frame in the same manner as the single pitch "Selectric" Typewriter escapement rack. The horizontal rest position of the escapement rack is controlled by a pin that is pressed into the right end of the escapement rail. The left end of the escapement rack extends through the escapement rack bearing plate which is mounted to the left side of the power frame. (Fig. 2)

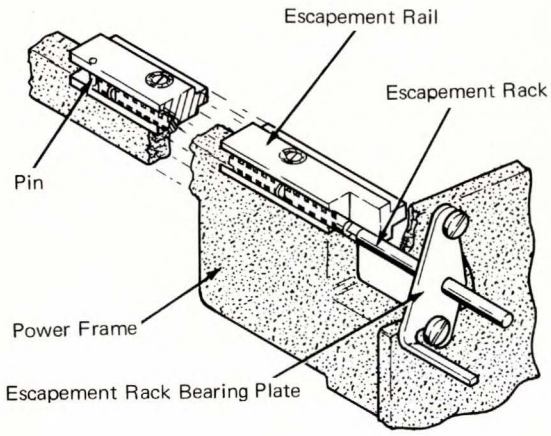


Figure 2 – Escapement Rack Mounting (Left Rear View)

The rotation of the escapement rack is accomplished by the switch pitch lever, switch pitch sector gear and escapement rack gear. The switch pitch lever is mounted to the switch pitch sector gear and the assembly pivots on an extension of the multiple copy control shaft. The teeth of the sector gear engage the teeth of the escapement rack gear which is setscrewed to the left end of the escapement rack. As the switch pitch lever is operated, the sector gear moves up or down rotating the escapement rack gear. (Fig. 3)

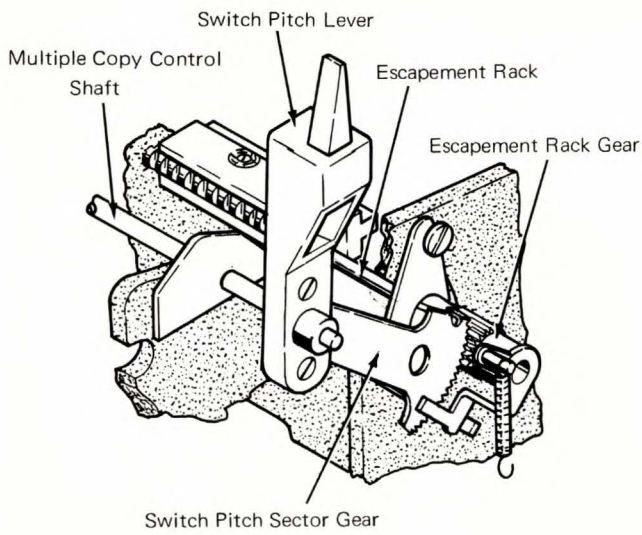


Figure 3 – Escapement Rack Gear And Switch Pitch Sector Gear (Left Rear View)

The escapement rack gear stop lug controls the two rest positions of the escapement rack. In the 10 pitch mode, the stop lug is spring loaded against the half backspace lever mounting stud by the escapement rack gear toggle spring. When the gear is switched to the 12 pitch mode, it toggles over and the stop lug is spring loaded against a lug on the escapement rack bearing plate. (Fig. 4)

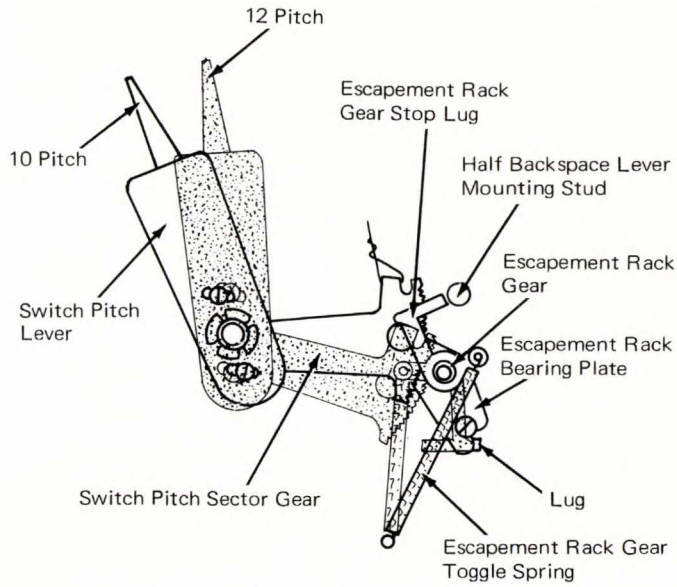


Figure 4 – Escapement Rack Rotation (Left Side View)

MARGIN RACK ROTATION

The left end of the margin rack is mounted in a bushing that is retained in a hole in the power frame. The right end of the margin rack is mounted in the overbank guide bracket. The margin rack supports the margin rail. The margin release bracket is mounted to the margin rail. A lug on the margin release bracket engages a notch in the margin rack causing the rack and the rail to move left to right as a unit. The left to right position of the margin rack/rail and overbank motion are controlled by the overbank guide. (Fig. 5)

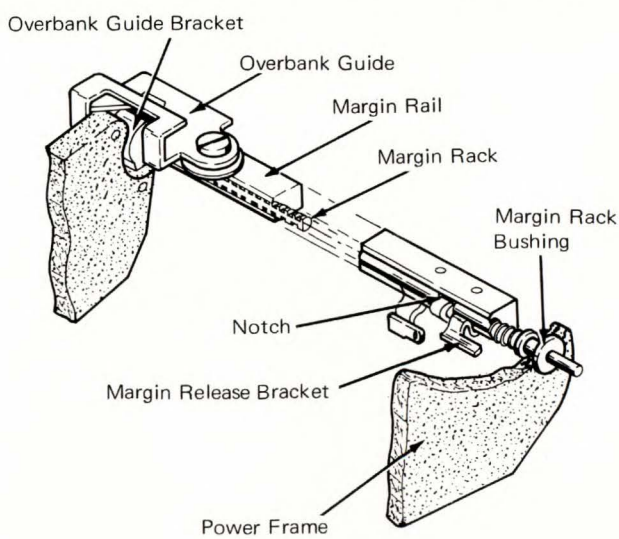


Figure 5 – Margin Rack Mounting (Left Rear View)

The margin rack is rotated by the margin pitch link and the margin rack gear. The teeth of the margin pitch link engage the teeth of the margin rack gear which is setscrewed to the left end of the margin rack. The rear end of the margin pitch link is mounted to the escapement rack gear. As the escapement rack gear is rotated, the margin pitch link moves front to rear rotating the margin rack gear. (Fig. 6)

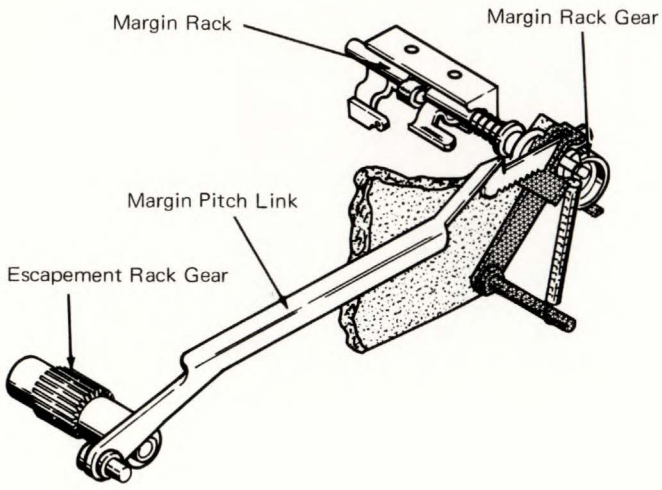


Figure 6 – Margin Pitch Link And Margin Rack Gear (Left Rear View)

The two rest positions of the margin rack gear are controlled by two stops on the margin pitch link guide bracket. A lug on the margin rack gear is toggled and spring loaded against the stops in the same manner as the escapement rack gear. (Fig. 7)

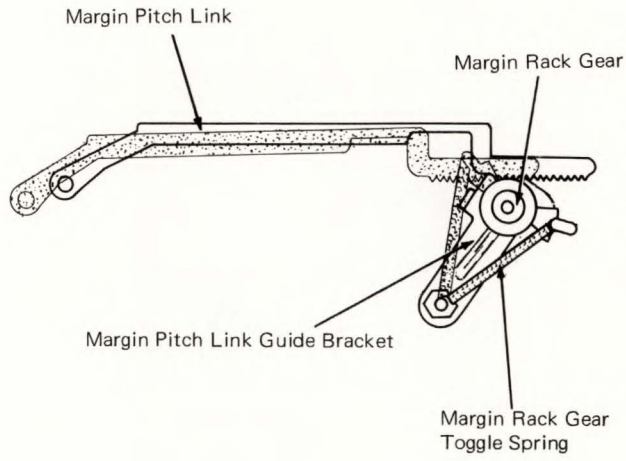
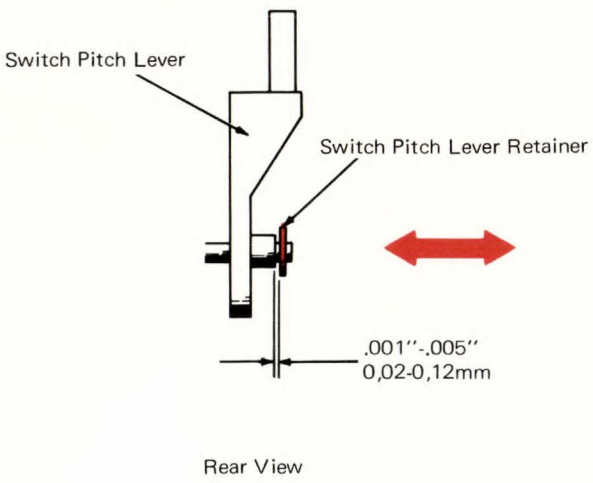


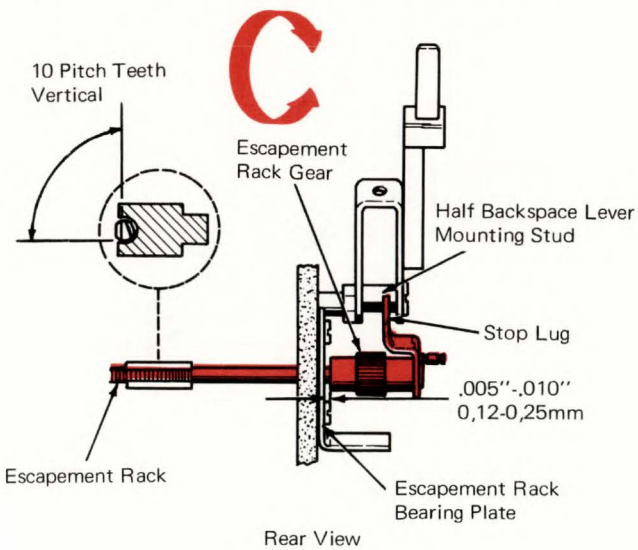
Figure 7 – Margin Rack Rotation (Left Side View)

SWITCH PITCH ADJUSTMENTS

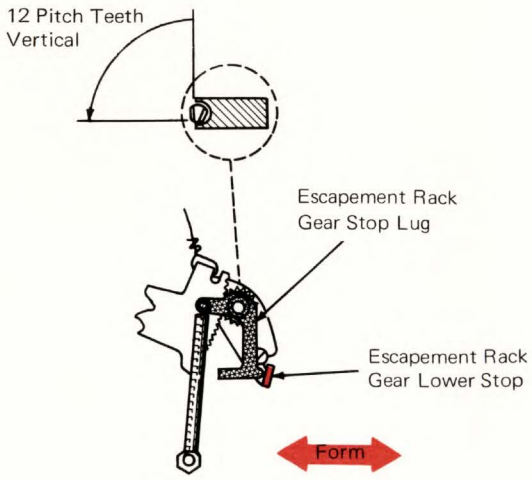
1. *Switch Pitch Lever* – Adjust the retainer for .001"-.005" end play of the switch pitch lever.



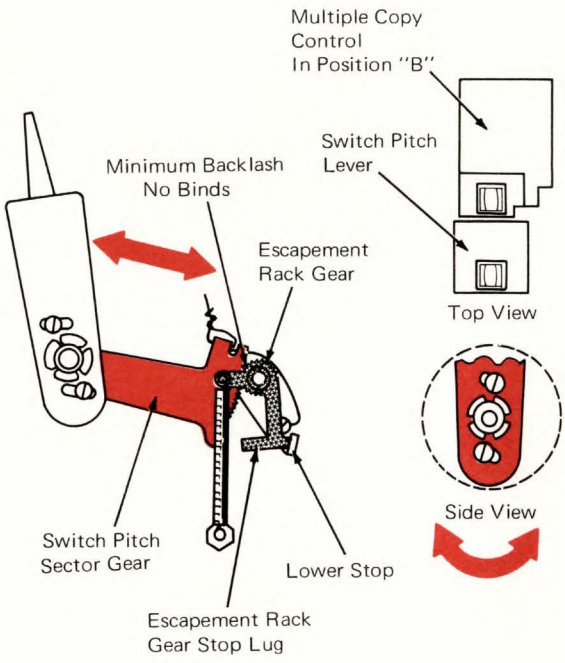
2. *Escapement Rack Gear* – With the escapement rack gear stop lug against the half backspace lever mounting stud, the 10 pitch escapement rack teeth must be vertical. A clearance of .005"-.010" must be maintained between the escapement rack gear and the escapement rack bearing plate when tightening the setscrews.



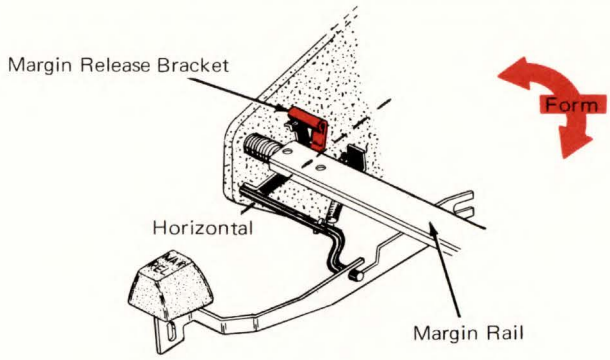
3. *Escapement Rack Gear Lower Stop* – Form the escapement rack gear lower stop so the 12 pitch escapement rack teeth are vertical when the escapement rack gear stop lug is against the stop.



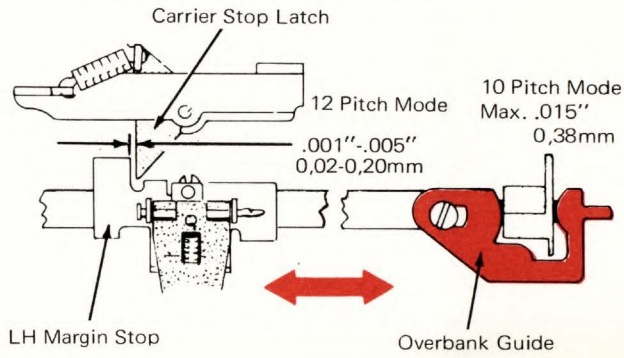
4. *Switch Pitch Sector Gear* – With the escapement rack gear stop lug against the lower stop, mesh the switch pitch sector gear with the escapement rack gear so the upper 2 teeth do not mesh. Adjust for minimum backlash with no binds. The switch pitch lever should be positioned to be parallel to the multiple copy control in the "B" position.



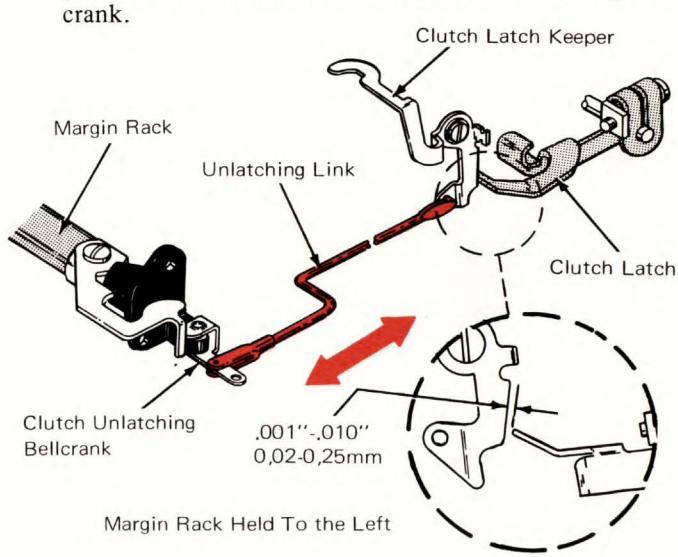
5. *Margin Rail Horizontal* – Form the margin release bracket so the margin rail rests on a horizontal plane.



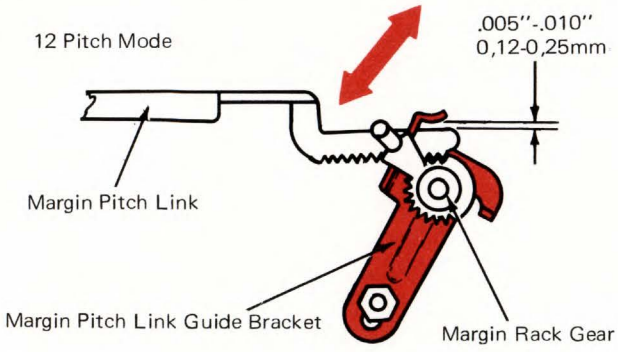
6. *Overbank* – Position the overbank guide left or right for .001"-.005" between the carrier stop latch and the left margin stop in the 12 pitch mode. In the 10 pitch mode the clearance must not exceed .015".



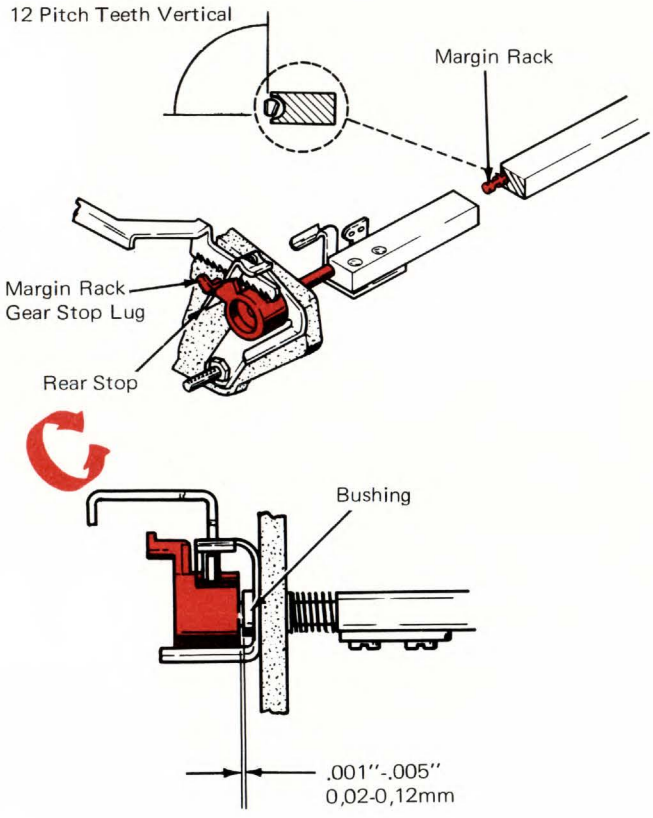
7. *Clutch Unlatching Link* – Adjust the carrier return clutch unlatching link for .001"-.010" between the latch and keeper with the carrier in the full overbank position. On dual pitch machines, the clevis should be placed in the outside hole of the clutch unlatching bellcrank.



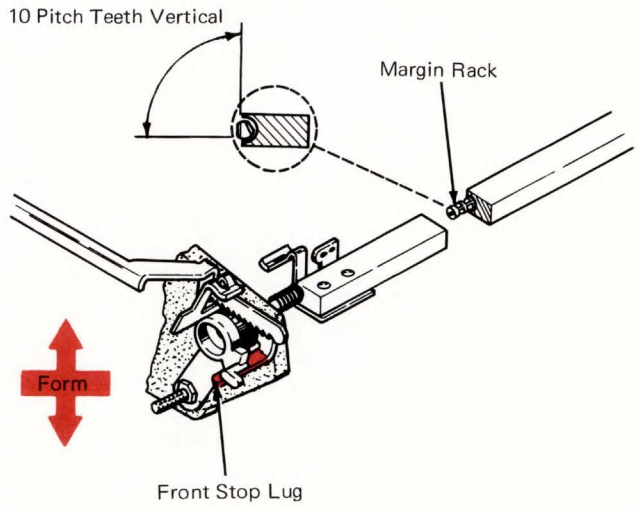
8. *Margin Pitch Link Guide Bracket* – With the machine in the 12 pitch mode, mesh the first tooth of the margin pitch link with the first tooth of the margin rack gear. Adjust the margin pitch link guide bracket up or down for .005"-.010" clearance between the guide bracket lug and the top edge of the margin pitch link. This allows the margin pitch link to have minimum backlash and not bind with the margin rack gear.



9. *Margin Rack Gear* – With the margin rack gear against the rear stop, rotate the margin rack until the 12 pitch teeth are vertical. Maintain .001"-.005" clearance between the margin rack gear and the bushing when tightening the setscrews.



10. *Front Margin Rack Gear Stop* – Form the front margin rack gear stop lug so the 10 pitch margin rack teeth are vertical in the 10 pitch mode.



The half backspace mechanism enables the typist to operate a lever which moves the carrier one half space to the left. As long as the half backspace lever is held forward, the carrier remains one half space to the left and the typewriter will type between the normal escapement positions. This is accomplished by moving the escapement rack one half space to the left. (Fig. 1)

The movement of the escapement rack is accomplished by the half backspace lever, intermediate bellcrank, intermediate lever and half backspace bellcrank. When the half backspace lever is operated, it operates the intermediate bellcrank, which operates the intermediate lever and pulls down on the half backspace bellcrank.

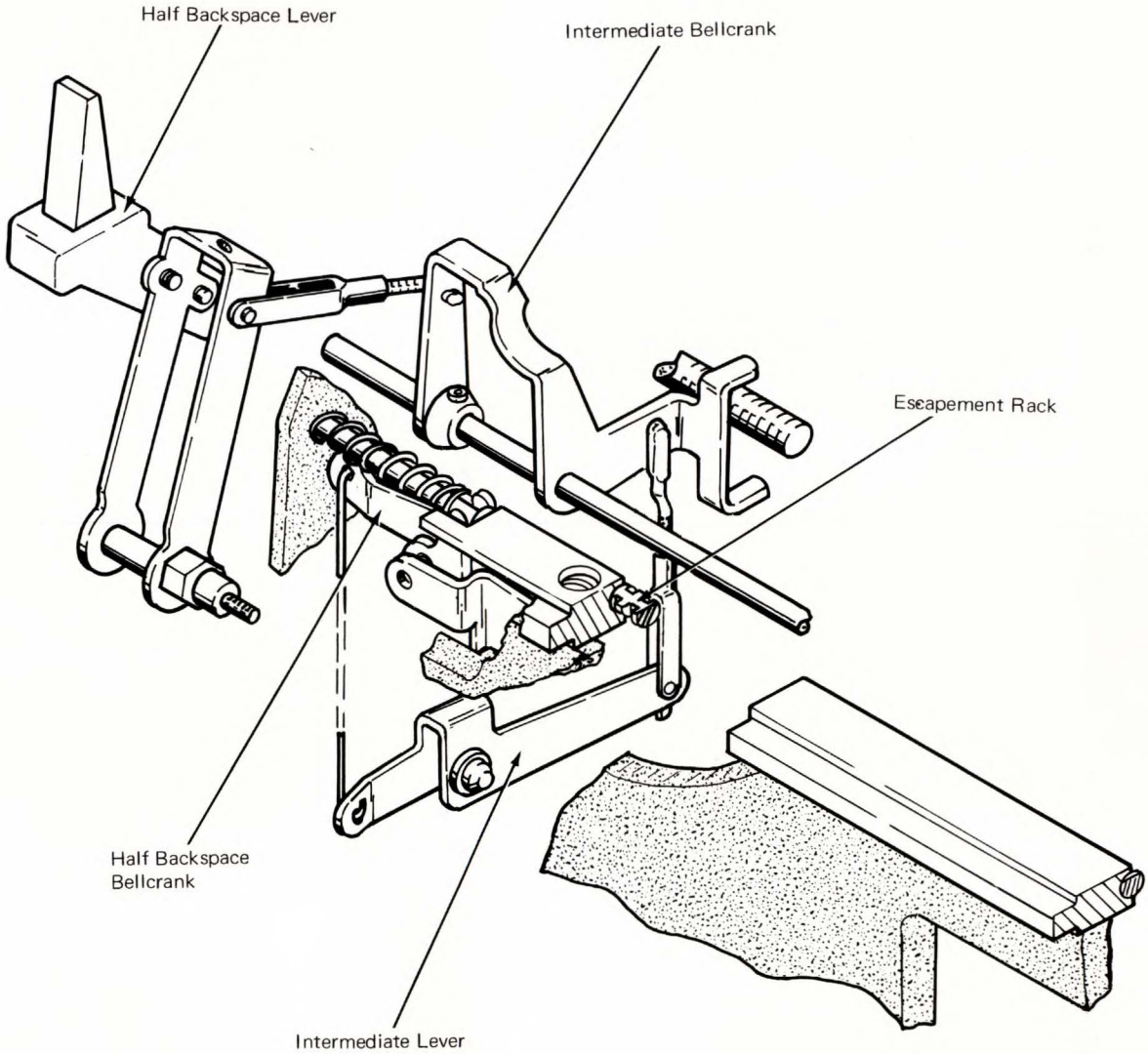


Figure 1 – Half Backspace Mechanism

A lug on the half backspace bellcrank is seated in a notch in the escapement rack. As the bellcrank is operated, the lug moves to the left camming the escapement rack to the left. A compression spring restores the bellcrank and the escapement rack to their normal position. The working edge of the escapement rack notch has a step in it to compensate for the different motion requirements for the two pitches. (Fig. 2)

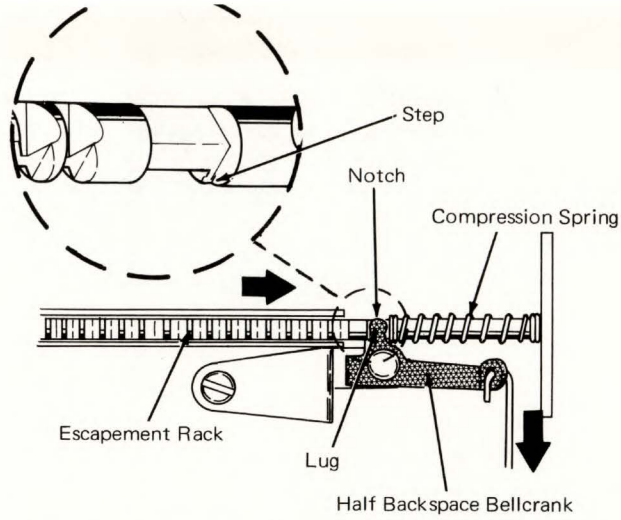
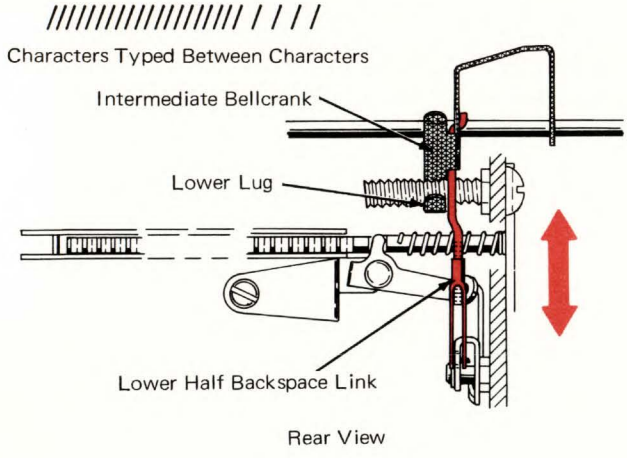


Figure 2 – Escapement Rack Movement (Rear View)

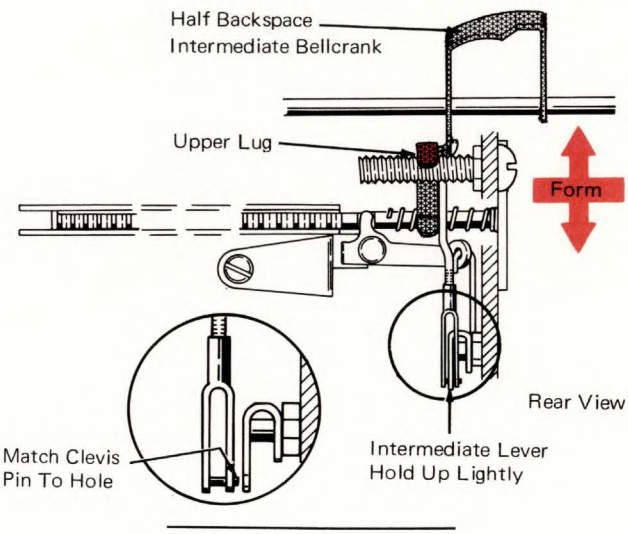
HALF BACKSPACE ADJUSTMENTS

1. *Lower Half Backspace Link* – Place the machine in the 10 pitch mode. Adjust the lower half backspace link to center characters typed when half backspace is operated between characters typed normally.

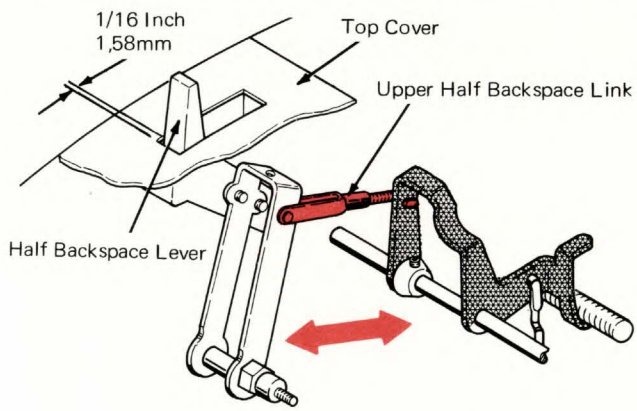
   NOTE: You may need to form the lower intermediate bellcrank lug to refine this adjustment.



2. *Half Backspace Rest Position* – Disconnect the lower half backspace link. Hold the rear of the half backspace intermediate lever up lightly. Form the upper lug on the half backspace intermediate bellcrank so the pin in the clevis just matches the hole in the intermediate lever. This ensures that the escapement rack will rest against the pin in the escapement rail when the half backspace mechanism is at rest.



3. *Half Backspace Lever* – In the operated position, adjust the upper half backspace link so the half backspace lever clears the top cover by approximately 1/16 inch.



The dual pitch tab mechanism can operate in either 10 or 12 pitch without any mechanical switching. This is accomplished by a universal tab rack. The tab stops are spaced in such a way that the escapement pawl will re-enter the proper rack tooth correctly in either pitch. (Fig. 1)

Dual pitch tab provides the operator with the same features as single pitch tab, but with two additional instructions:

1. The machine will not reliably tab from within one space of a set tab stop.
2. Before switching pitch, all tab stops should be cleared and necessary tab stops reset after the pitch is changed.

Dual pitch escapement functions in the same manner as single pitch escapement. The only differences are the escapement rack (covered in the Switch Pitch section), the escapement pawl and its mounting, and some adjustments. The pawl, its mounting, and a complete escapement adjustment sequence are covered in this section.

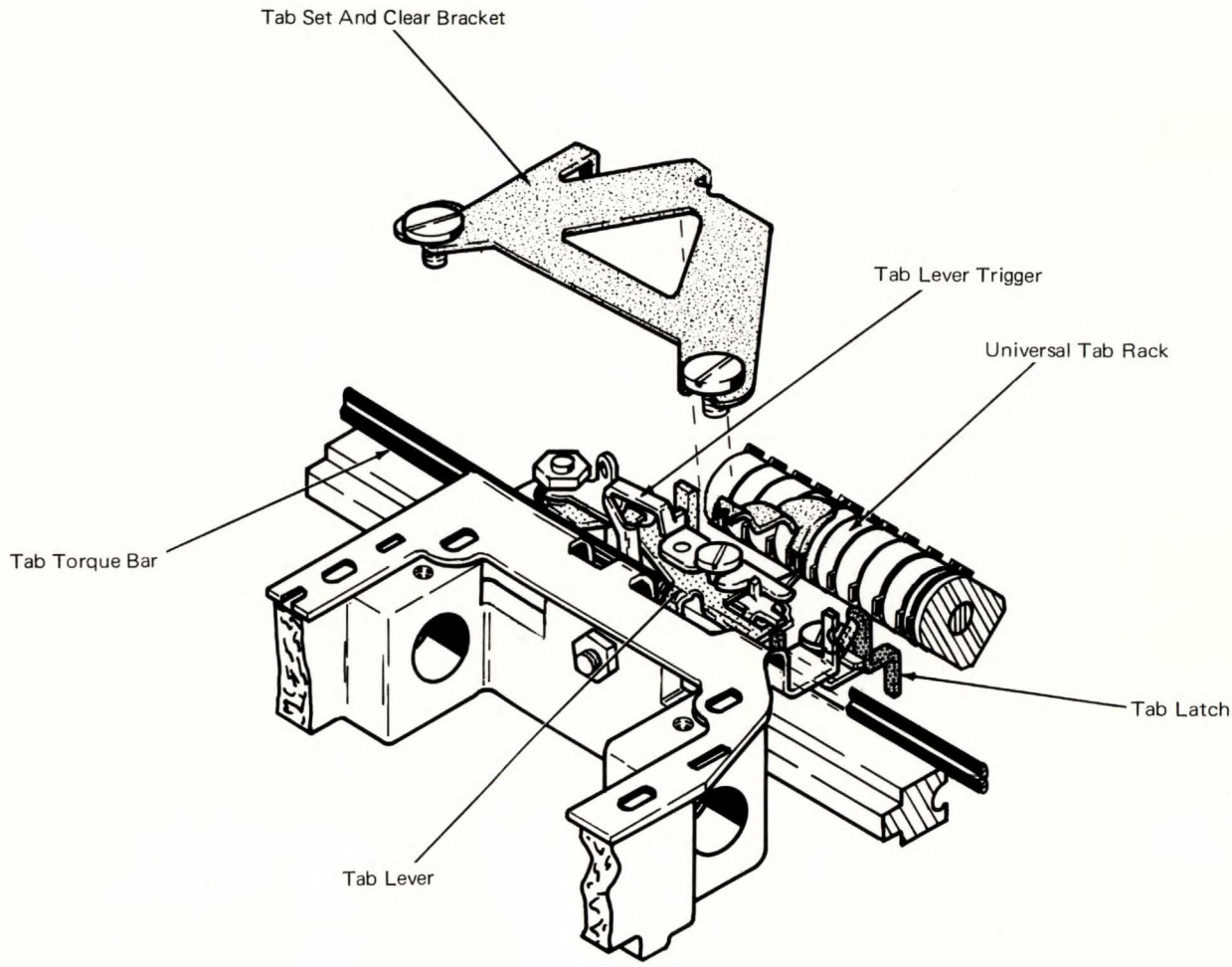


Figure 1 – Dual Pitch Tab

TAB SET AND CLEAR

The tab rack is rotated to set or clear a tab stop in the same manner as the single pitch "Selectric" Typewriter. However, the tab stops are both set and cleared by a lug on the tab set and clear bracket. In the 10 pitch mode, the tab set and clear lug will set or clear the two closely spaced tab stops at the same time. In the 12 pitch mode, it will set or clear them individually. (Fig. 2)

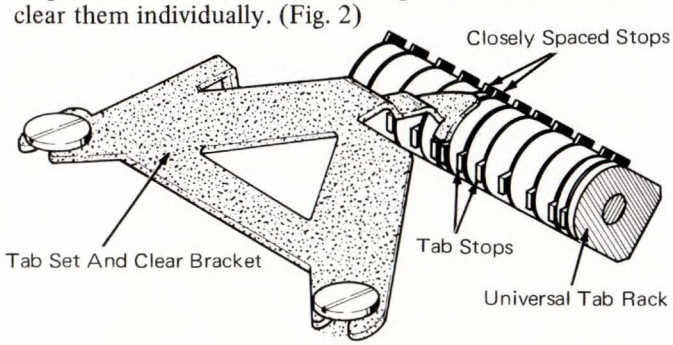


Figure 2 – Tab Set And Clear

TAB ACTUATING

The tab torque bar is pivoted to the rear in the same manner as a single pitch "Selectric" Typewriter. The tab torque bar contacts the tab lever trigger moving it to the rear. The tab lever trigger lug contacts the upper lug on the tab lever. As the tab lever moves to the rear, its lower lug contacts the escapement pawl, removing it from the escapement rack. (Fig. 3)

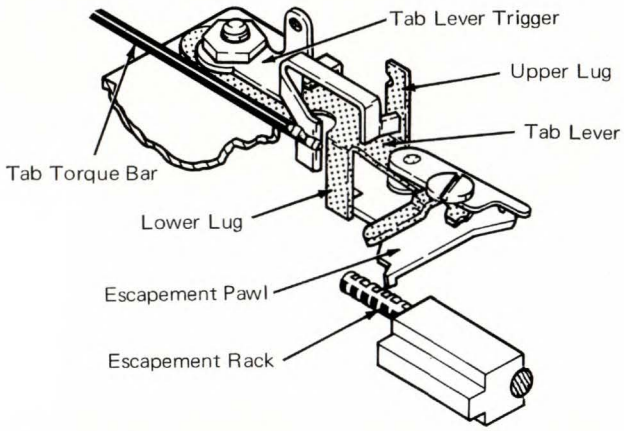


Figure 3 – Tab Actuating And Escapement Pawl Removal

The tab lever is latched by the latch lug of the tab latch rotating into the latching notch. The rear edge of the notch acts as a latching surface for the tab lever. The front of the notch contacts the latch lug and acts as an overthrow stop for the tab lever. The interlock lug on the tab latch rests behind the escapement torque bar and will cause the tab to be unlatched any time the escapement torque bar is operated. (Fig. 4)

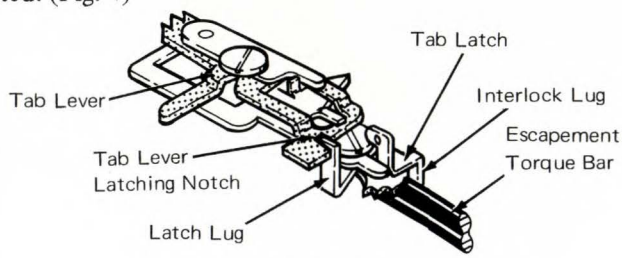


Figure 4 – Tab Lever Latching

The tab lever pawl is mounted to the tab lever by a shoulder screw. It pivots on the tab lever front to rear and is spring loaded toward the rear. This allows the tab lever to continue its rearward movement even though the tab lever pawl contacts the end of a set tab stop. This will occur occasionally because of the universal tab stop spacing. A tab lever pawl adjusting plate is mounted to the tab lever, controlling the amount of tab lever pawl bite on a set tab stop. (Fig. 5)

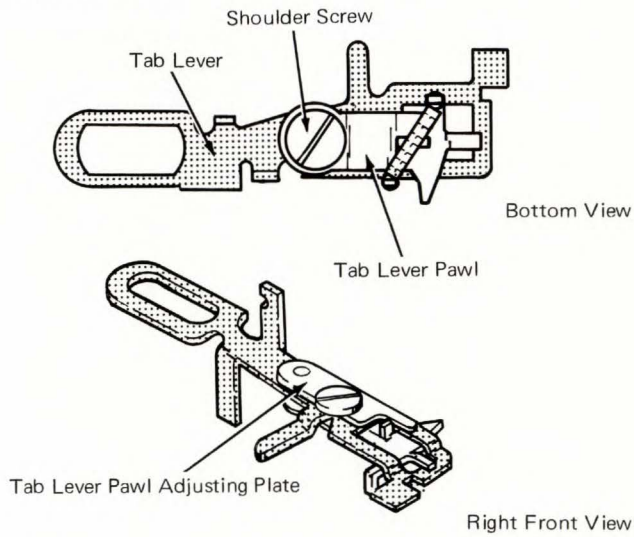


Figure 5 – Tab Lever Pawl Mounting

When the tab lever is latched out, the escapement pawl is removed from the escapement rack and the carrier moves to the right. The tab lever pawl contacts a set tab stop causing the tab lever to stop as the carrier continues to move to the right. After .020" of additional movement of the carrier, the escapement pawl drops from the lower lug on the tab lever and, under its spring tension, restores back into the escapement rack. Further movement of the carrier causes the tab lever to unlatch and restore to its rest position. The escapement pawl against the escapement rack tooth stops the carrier. (Fig. 6)

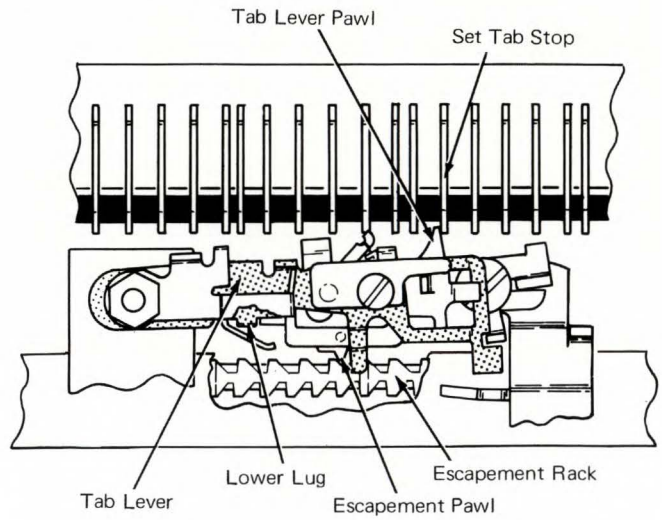


Figure 6 – Tab Operation

UNIVERSAL TAB STOP SPACING

The tab stops are spaced on the universal tab rack to accommodate both 10 and 12 pitch escapement racks. Figure 7 shows the tab lever pawl contacting a tab stop, if it were set, and approximately where the escapement pawl starts to enter the escapement rack tooth for that stop. Every 1/2 inch (5 teeth in 10 pitch and 6 teeth in 12 pitch) an escapement rack tooth is common for both pitches, therefore, the tab stop spacing is repeated every 1/2 inch. (Fig. 7)

This is shown for illustrative purposes only. Keep in mind that the machine will not tab reliably from within one space of a set tab stop.

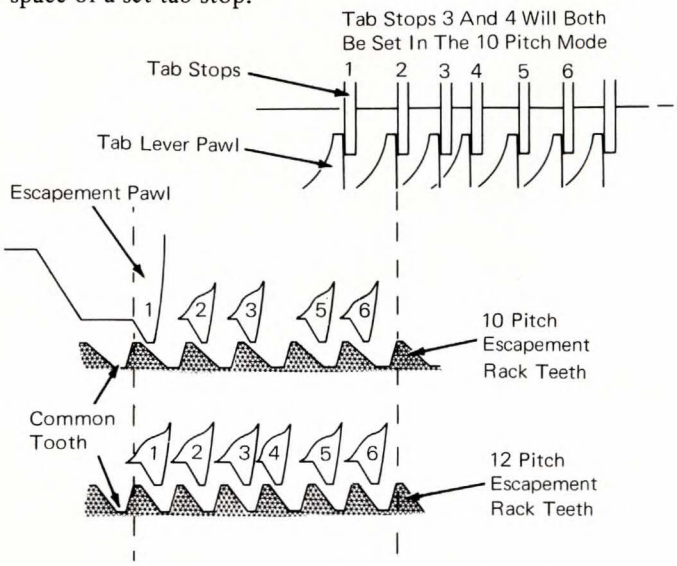

Tab Stops 3 And 4 Will Both Be Set In The 10 Pitch Mode
Tab Stops
1 2 3 4 5 6
Tab Lever Pawl
Escapement Pawl
1 2 3 5 6
10 Pitch Escapement Rack Teeth
Common Tooth
1 2 3 4 5 6
12 Pitch Escapement Rack Teeth

Figure 7 – Universal Tab Stop Spacing

DUAL PITCH ESCAPEMENT

In the dual pitch escapement mechanism, the vertical position of the escapement pawl is critical. The pawl must be centered in the escapement rack within the opening in the escapement rail. An escapement pawl guide bracket is mounted above the escapement pawl. The escapement pawl guide lug extends down from the bracket and is formed under the escapement pawl to control its vertical movement. The escapement pawl vertical position is controlled by the vertical position of the rear of the carrier, which is adjustable. This is accomplished by a diagonal elongated mounting slot in the rear carrier shoe. As the carrier shoe is adjusted left or right, the rear of the carrier is raised or lowered. (Fig. 8)

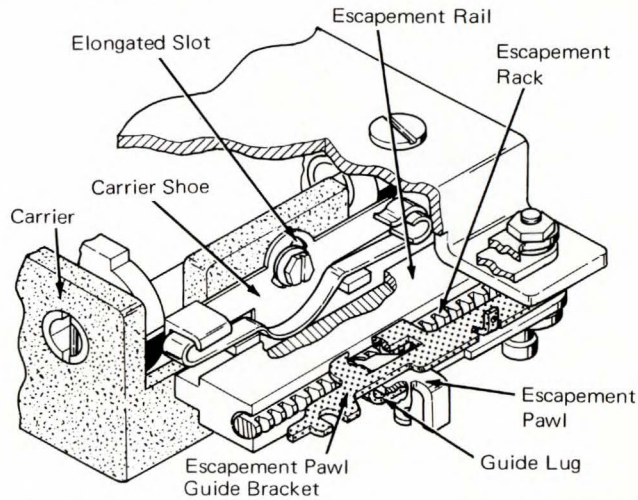
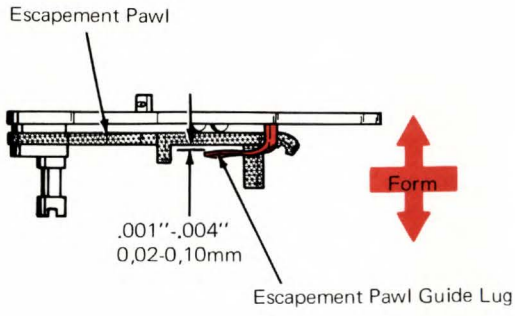


Figure 8 – Escapement Pawl And Carrier Shoe Mounting (Right Rear View)

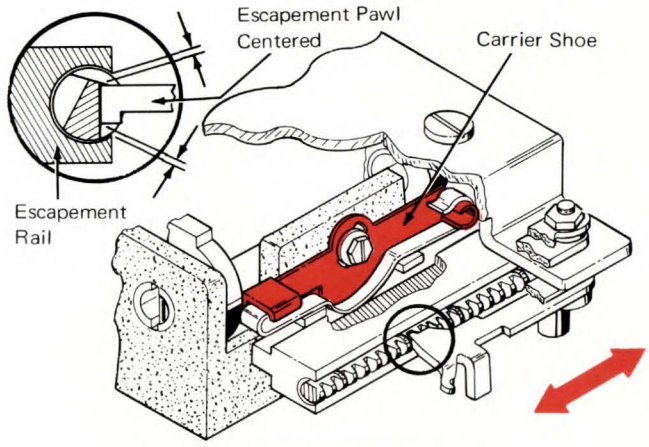
ESCAPEMENT ADJUSTMENTS

1. *Escapement Pawl Guide Lug* – Form the escapement pawl guide lug for .001"-.004" clearance between the lug and the escapement pawl.

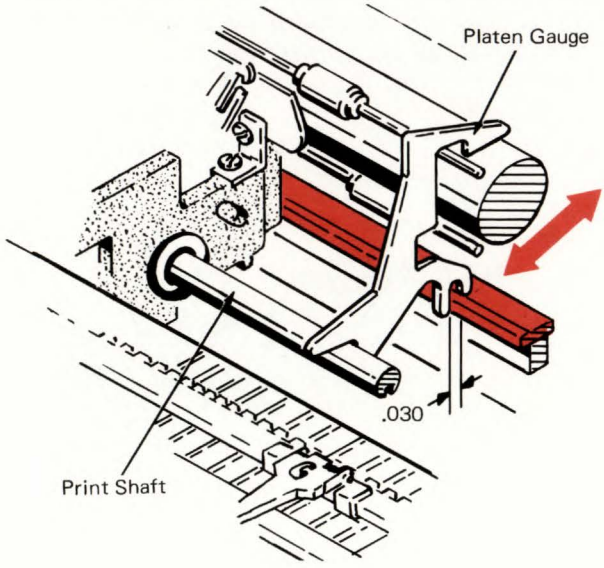


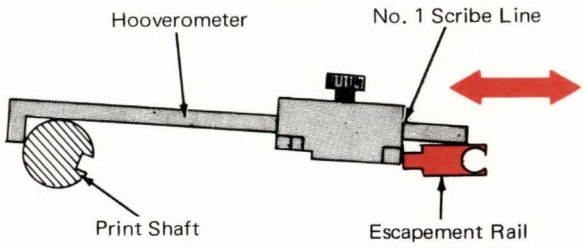
2. *Carrier Shoe* – Adjust the carrier shoe left or right to center the escapement pawl in the opening of the escapement rail.

   NOTE: After making this adjustment, check carrier movement along the full writing line. The carrier shoe could cock when tightening the mounting screw and cause the carrier to bind.

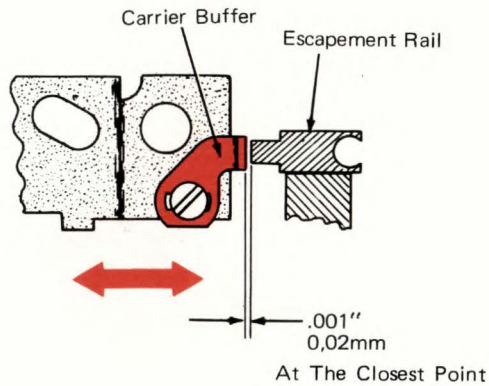


3. *Escapement Rail* – With the print shaft rotated so the keyway is down, position the platen gage to rest on the print shaft and the escapement rail. The correct position of the escapement rail is the distance spanned by the gage plus .030". Adjust the escapement rail to this dimension and parallel to the print shaft. If the platen gage is not available, the escapement rail position may be set from the No. 1 scribe line on the hooverometer. It should just span the distance from the print shaft.

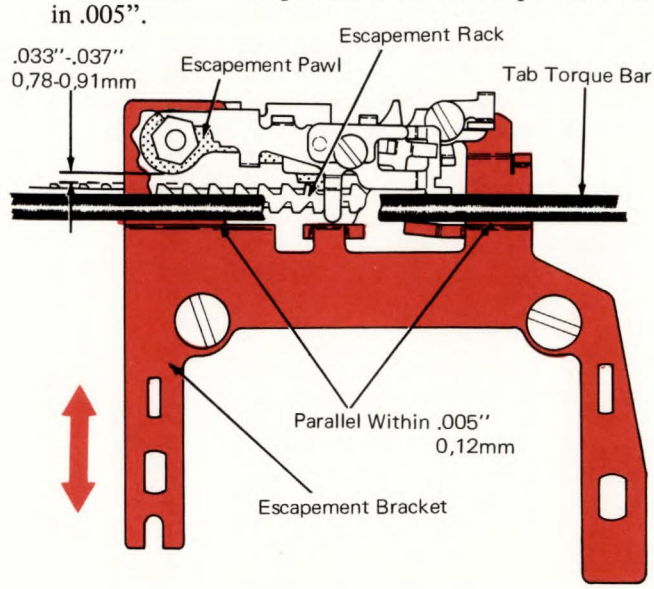




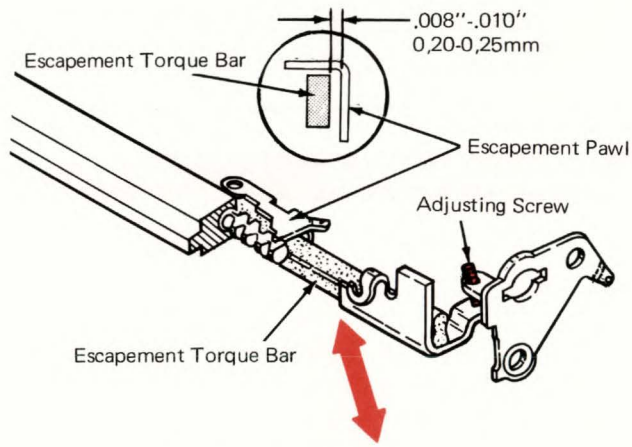
4. *Carrier Buffer* – Adjust the carrier buffer for .001" clearance between the buffer and the escapement rail at the closest point.



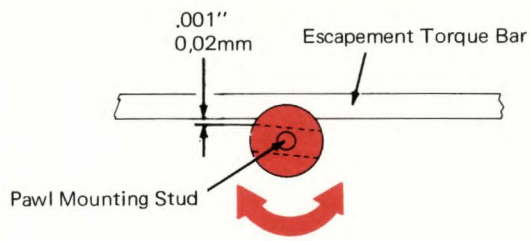
5. *Escapement Bracket* – Position the escapement bracket front to rear so the front left side of the escapement pawl clears an escapement rack tooth by .033"-.037". The bracket must be parallel to the tab torque bar within .005".



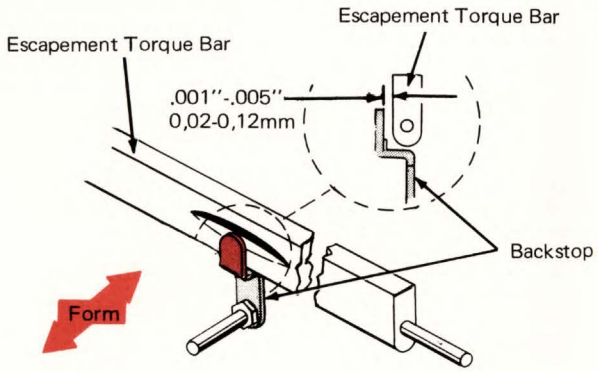
6. *Escapement Torque Bar Stop* – Adjust the escapement torque bar stop to obtain .008"-.010" clearance between the rear of the torque bar and the lug on the escapement pawl with all parts at rest.



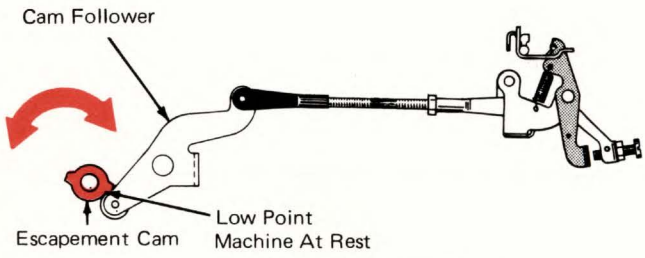
7. *Pawl Mounting Stud* – Adjust the pawl mounting stud rotationally to obtain .001" clearance between the mounting stud and the front of the escapement torque bar. Keep the eccentric in the right half of its orbit.



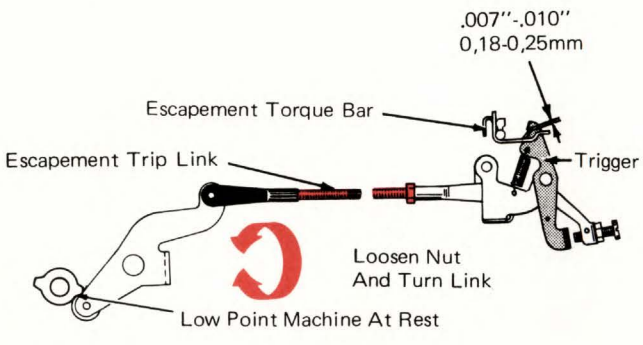
8. *Torque Bar Backstop* – Form the backstop front to rear to obtain .001"-.005" clearance between the stop and the rear of the torque bar.



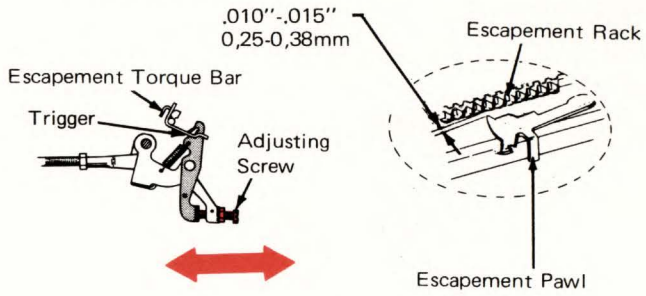
9. *Escapement Cam* – With the machine at rest, adjust the cam radially on the filter shaft so the cam follower roller is resting at the start of the low dwell.



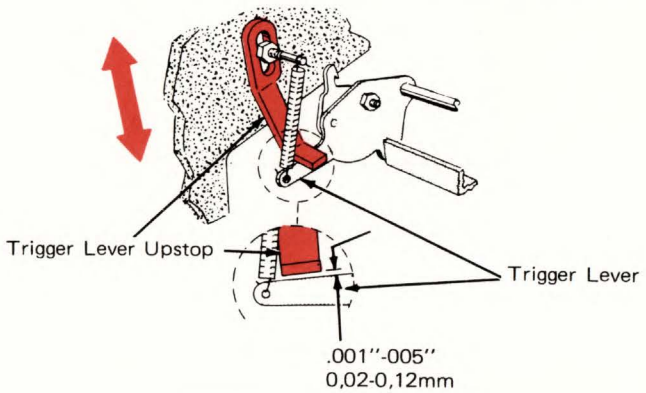
10. *Escapement Trip Link* – With the machine latched at rest, adjust the escapement trip link to obtain .007"-.010" clearance between the hook on the trigger and the extension on the escapement torque bar. Be sure the trigger lever upstop is not restricting the trigger.



11. *Trigger Knockoff* – Adjust the knockoff adjusting screw so the escapement trigger will cam off the torque bar lug when the escapement pawl clears the rack by .010"-.015".



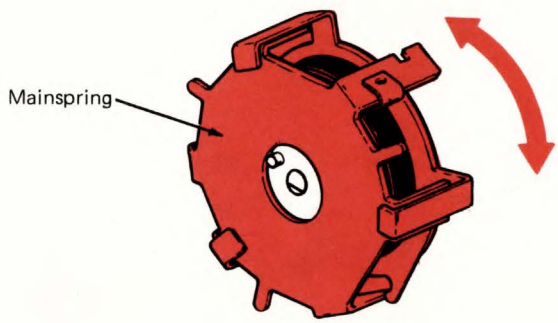
12. *Trigger Lever Upstop* – With all parts at rest, adjust the trigger lever upstop vertically to obtain .001"-.005" clearance between the upstop and the trigger lever.



13. *Mainspring* – Adjust the mainspring for 1/2 to 3/4 of a pound as the carrier tabs through the right hand margin.

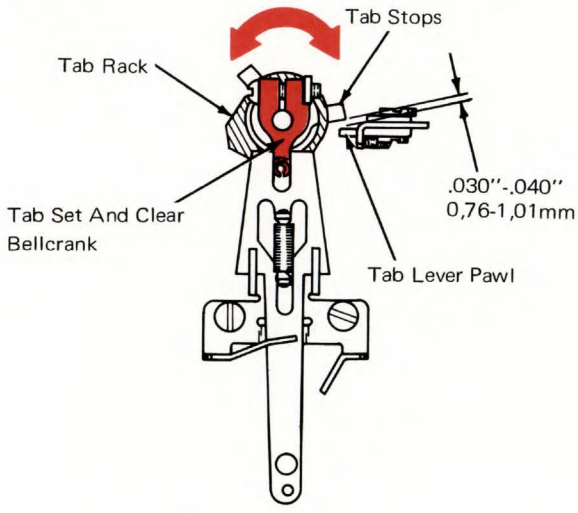
NOTE: With the carrier resting at the extreme right hand margin, wind the mainspring approximately seven turns.

CAUTION: The mainspring should be handled with care to prevent it from slipping when the tension is being increased or decreased.

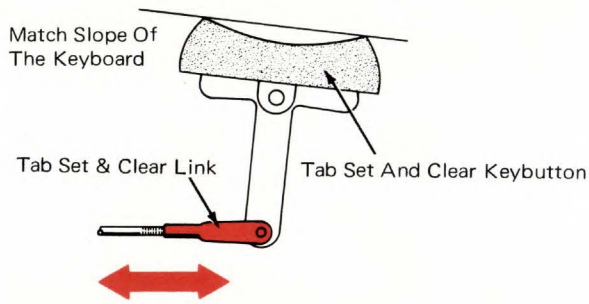


DUAL PITCH TAB ADJUSTMENTS

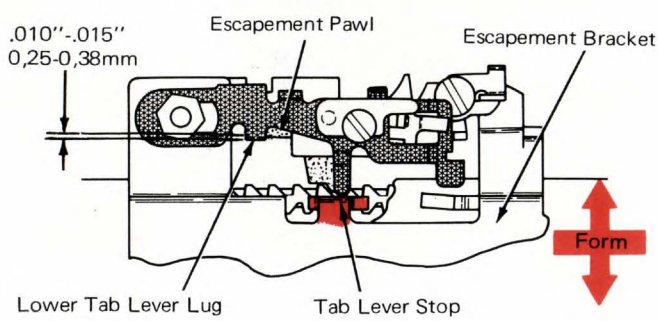
1. *Tab Rack Radially* – Position all the tab stops to the rear of their slots. Latch out the tab lever. Adjust the tab rack radially within the tab set and clear bellcrank for .030"-.040" between the tab stops and the tab lever pawl.



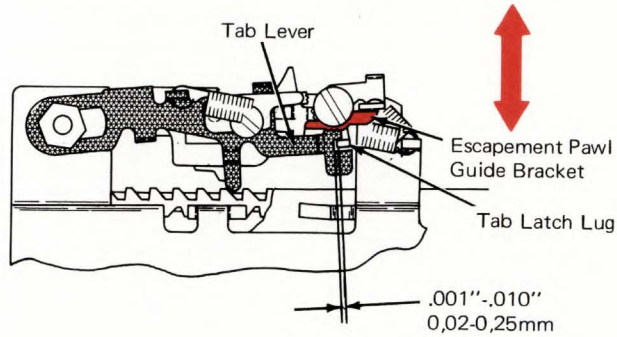
2. *Tab Set And Clear Link* – Adjust the tab set and clear link so the tab set and clear keybutton matches the slope of the keyboard.



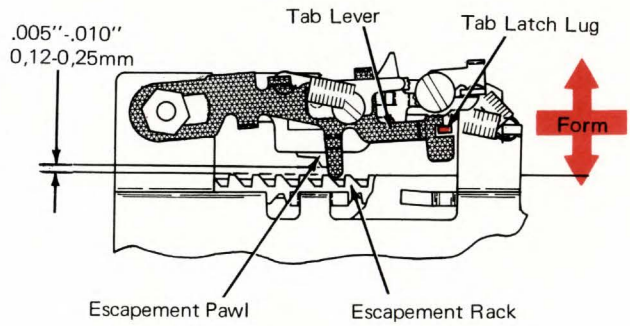
3. *Tab Lever Stop* – Form the tab lever stop on the escapement bracket so the lower tab lever lug clears the escapement pawl by .010"-.015" at rest.



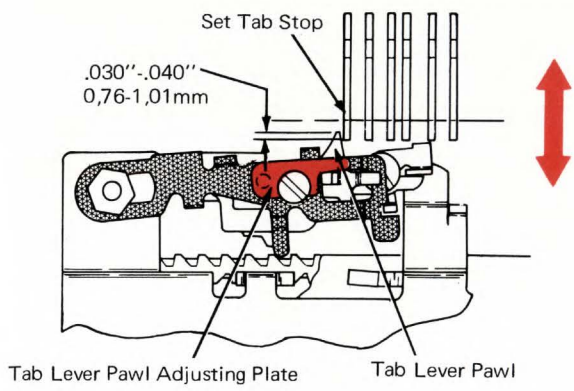
4. *Tab Latch Bite* – With the tab lever latched out, adjust the escapement pawl guide bracket front to rear so the left edge of the tab latch lug clears the bottom of the latching slot in the tab lever by .001"-.010".



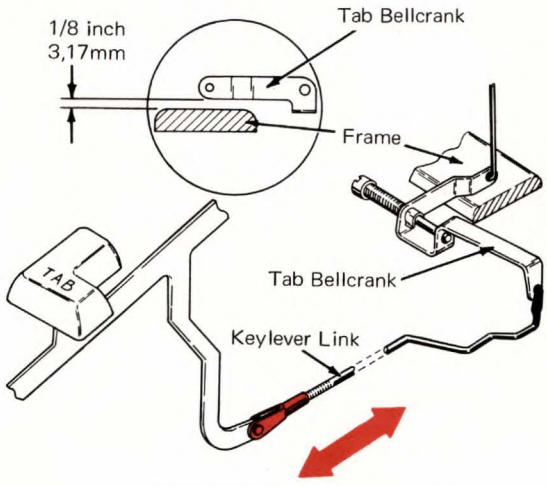
5. *Escapement Pawl Clearance* – With the tab lever latched out, form the tab latch lug so the escapement pawl clears the escapement rack by .005"-.010".



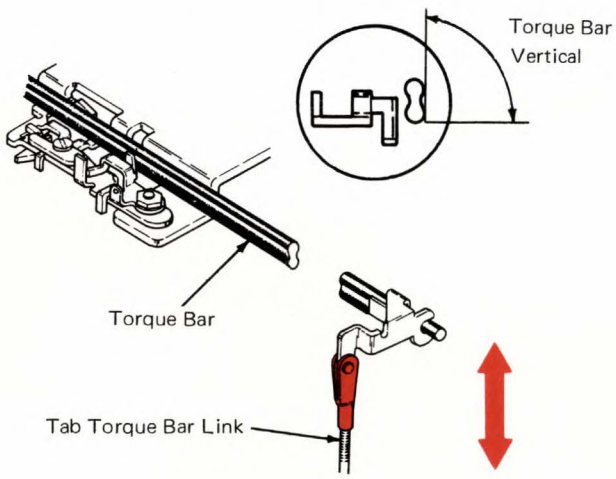
6. *Tab Lever Pawl Bite* – With the tab lever latched out, adjust the tab lever pawl adjusting plate so the tab lever pawl engages a set tab stop by .030"-.040".



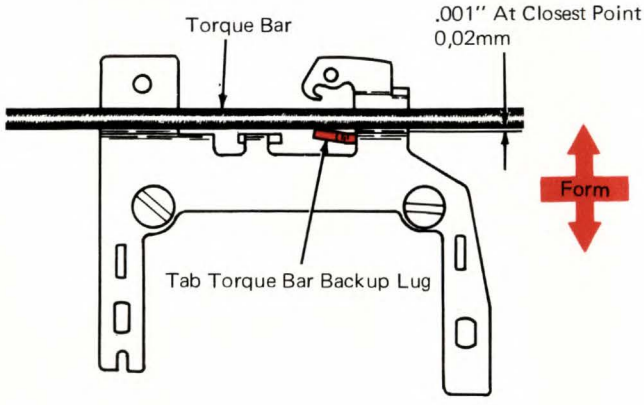
7. *Tab Keylever Link* – Adjust the tab keylever link so the rear arm of the tab bellcrank clears the bottom frame by approximately 1/8 inch.



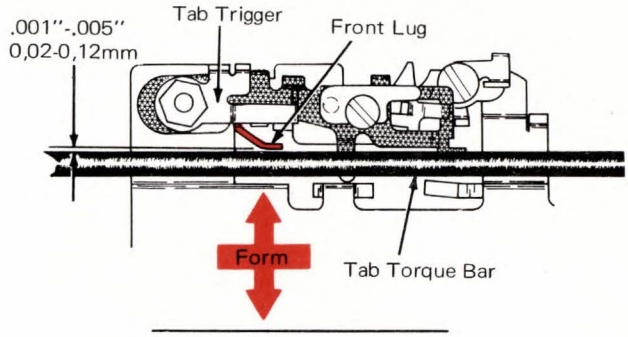
8. *Tab Torque Bar Link* – Adjust the tab torque bar link so the tab torque bar rest position is vertical.



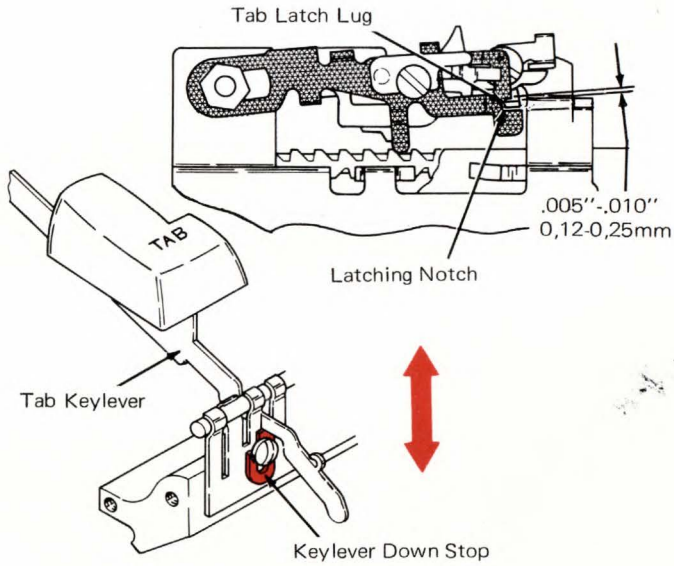
9. *Tab Torque Bar Backup Lug* – Form the tab torque bar backup lug for .001" clearance from the tab torque bar at the closest point.



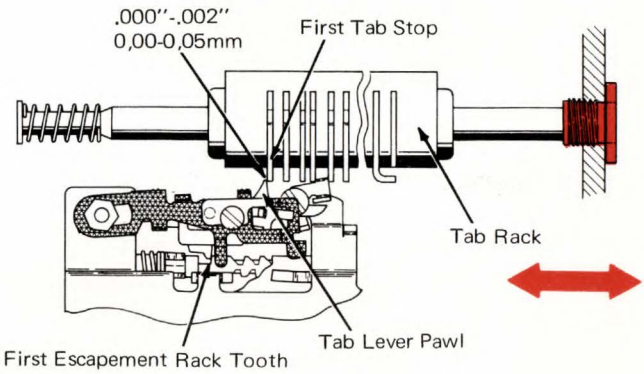
10. *Tab Trigger* – Form the front lug on the tab trigger so it clears the tab torque bar by .001"-.005".



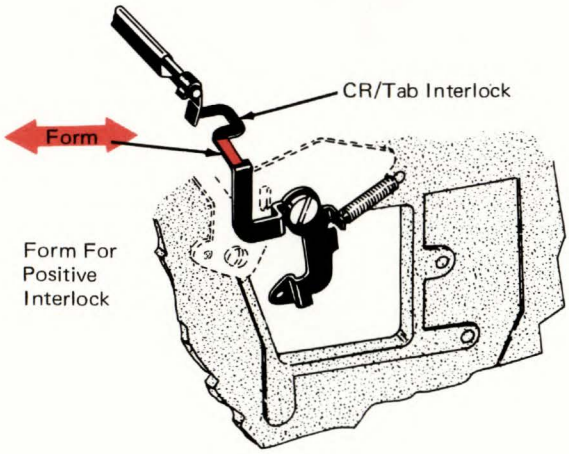
11. *Tab Keylever Down Stop* – With the tab keylever bottomed, adjust the tab keylever down stop so there is .005"-.010" clearance between the tab latch lug and the rear surface of the tab lever latching notch.



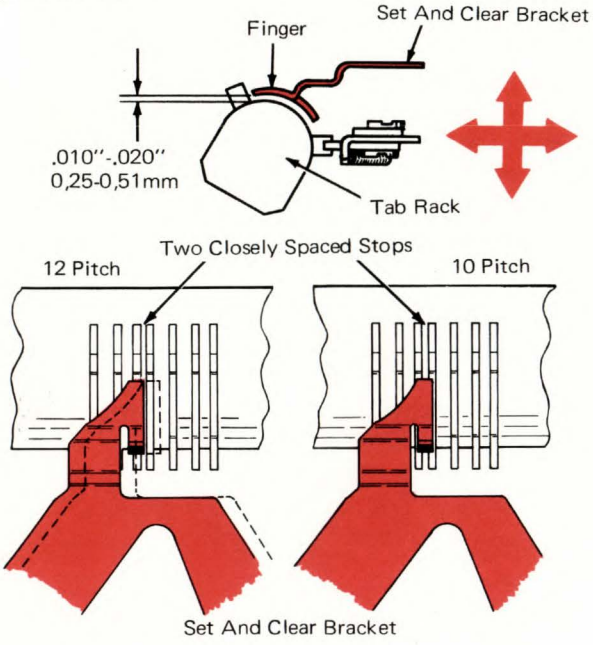
12. *Tab Rack Left To Right* – Place the machine in the 10 pitch mode. Set the first tab stop and position the carrier at the extreme left (first escapement rack tooth). As the tab lever is moved to the rear, adjust the tab rack left to right so the tab lever pawl clears the set tab stop by .000"-.002".



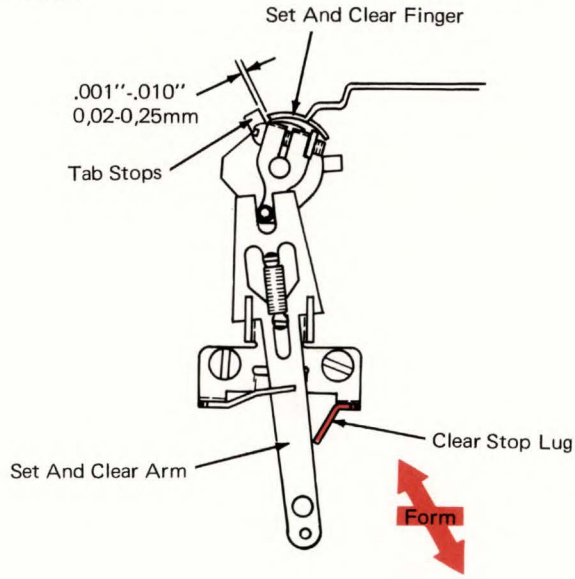
13. *Carrier Return/Tab Interlock* – Form the lug of the interlock to obtain the following conditions:
    a. With the carrier return mechanism latched, the interlock should pull the carrier return latch keeper forward just enough to release the latch when the tab lever is fully depressed.
    b. With the carrier return mechanism at rest, full depression of the tab keylever should not cause the carrier return keeper to move away from the latch.



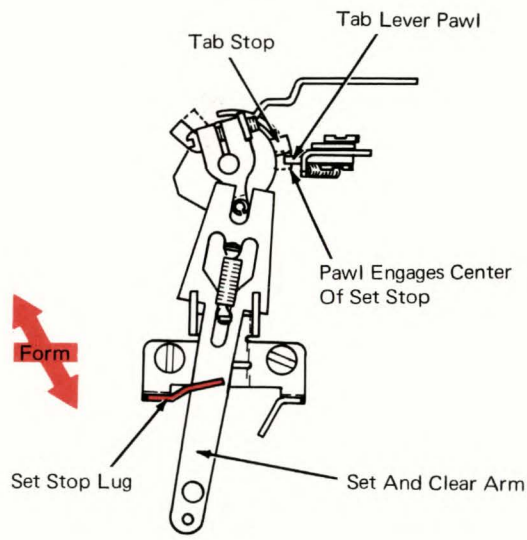
14. *Tab Set And Clear Bracket* – Adjust the tab set and clear bracket front to rear for .010"-.020" clearance between the contour of the set and clear finger and the contour of the tab rack. Adjust left to right so that the set finger will reliably set and clear each tab stop individually when the machine is in the 12 pitch mode and will set and clear the two stops that are spaced close together simultaneously when the machine is in the 10 pitch mode.



15. *Tab Clear Stop Lug* – Form the clear stop lug of the tab set and clear arm bracket so the tab stops, at the extreme rear of their slots, are .001"-.010" from the tab set and clear finger when the tab set and clear arm is against the lug. This ensures minimum noise during gang clear.



16. *Tab Set Stop Lug* – Form the set stop lug on the tab set and clear arm bracket so the tab lever pawl engages the center of a tab stop, when set.



The "Selectric" II Typewriter rotary backspace mechanism pulls the carrier return/backspace cable to move the carrier to the left one space at a time. This mechanism must function reliably in either the 10 or 12 pitch mode.

Because of this different method of backspacing, the carrier transport system is somewhat different than the "Selectric" Typewriter. The major difference in the transport system is the use of steel cables that are stretch resistant and stronger, in place of nylon cords. The tab/escapement cable is anchored in approximately the same manner as the "Selectric" Typewriter tab/escapement cord. The carrier return/backspace cable is anchored at the carrier to an arm on the cable anchor bracket that is free to pivot. This arm is heavily spring loaded to the right against a stop lug. The purpose of the pivot arm and spring is to act as a shock absorber when the carrier is pulled to the left by the cable. The other end of the cable is attached to the carrier return/backspace cable drum. The carrier return/backspace cable drum and backspace ratchet are one piece and operate as a unit. (Fig. 1)

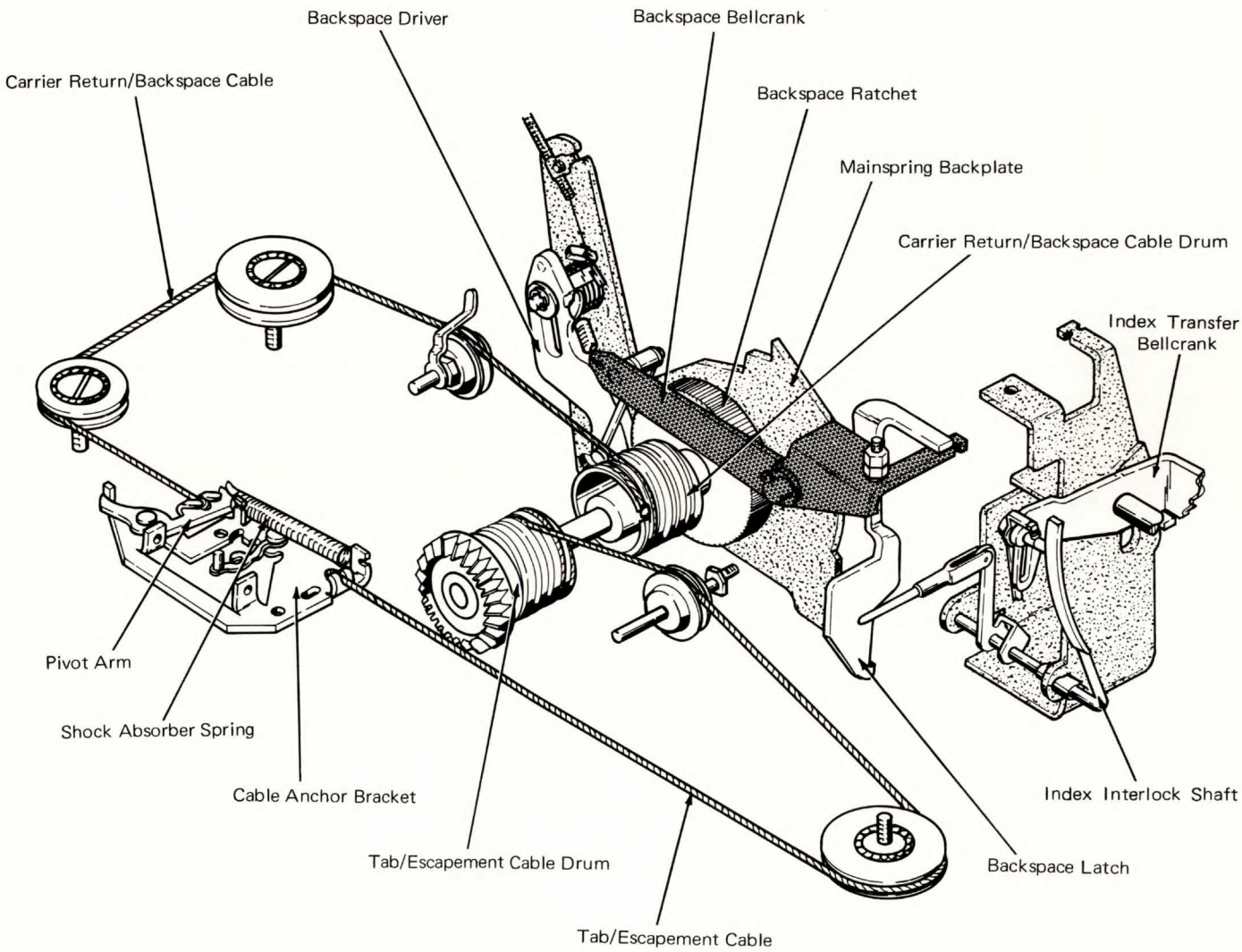


Figure 1 – Rotary Backspace Mechanism (Right Front View)

For proper operation, it is necessary to maintain a constant tension on the transport cables. The tab/escapement cable drum is setscrewed to the front of the escapement shaft. The cable tension arm has a "D" shaped hole that fits over a flat surface on the rear end of the escapement shaft. The carrier return/backspace cable drum assembly is free to rotate on the escapement shaft independently of the cable tension arm and the tab/escapement cable drum. The cable tension spring is connected between a lug on the cable tension arm and the spring anchor stud on the carrier return/ backspace cable drum assembly. This system, through the cable tension arm and escapement shaft, maintains a counterclockwise pull on the tab/escapement cable drum and a clockwise pull on the carrier return/ backspace cable drum assembly, therefore, keeping the transport cables taut. (Fig. 2)

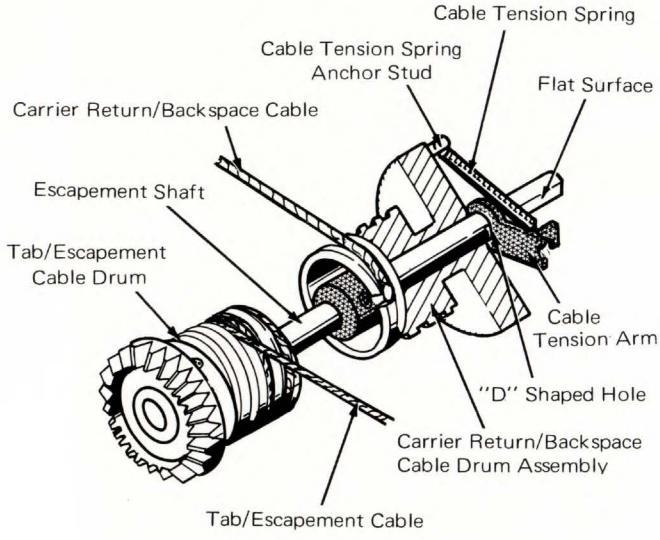


Figure 2 – Cable Tension System (Right Front View)

ROTARY BACKSPACE OPERATION

Rotary backspace operates from the same single lobed cam and cam follower as carrier return and index. On the dual pitch "Selectric" II Typewriter, spacebar is the only function operated by the double lobed cam. This simplifies spacebar adjustments.

The operation of the backspace mechanism from the keybutton to the backspace latch is covered in the Operational Control section of the "Selectric" Typewriter Service Manual.

It was mentioned earlier that the backspace ratchet and the carrier return/backspace cable drum are one piece. If the backspace ratchet rotates clockwise (as viewed from the front), the cable drum will rotate pulling the carrier return/ backspace cable. This is accomplished by the backspace latch, backspace bellcrank, backspace links and backspace driver. The bellcrank and driver are mounted on studs on the mainspring backplate. The driver mounting hole is an elongated slot. (Fig. 3)

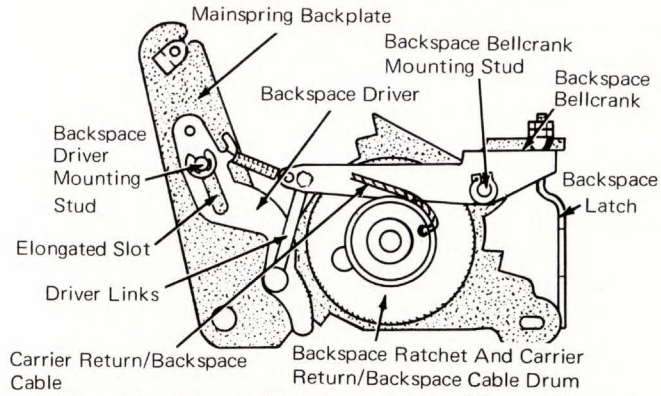


Figure 3 – Rotary Backspace At Rest (Front View)

As the latch is pulled downward by the cam follower, it pulls downward on the right end of the bellcrank causing the left end to move upward. The bellcrank is connected to the driver by the driver links and spring. As the left end of the bellcrank moves up, it pulls up on the driver links. The manner in which the driver spring and driver links are connected to the driver cause it to initially pivot or rotate on its mounting stud until it contacts the backspace ratchet. (Fig. 4)

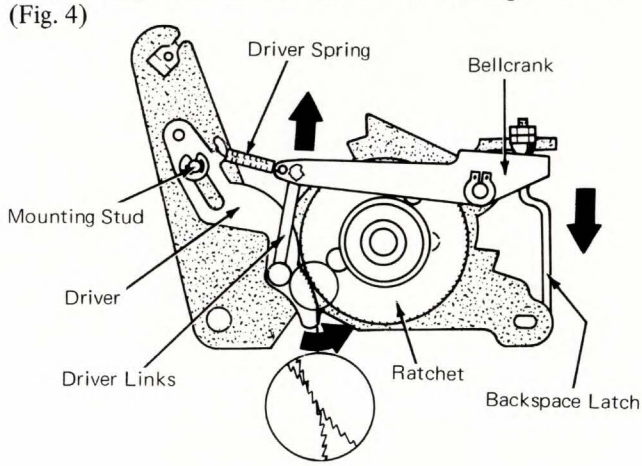


Figure 4 – Initial Driver And Bellcrank Motion (Front View)

When the backspace driver teeth have seated in the teeth of the backspace ratchet, the driver no longer pivots but starts to drive upward in its elongated slot, rotating the backspace ratchet. (Fig. 5)

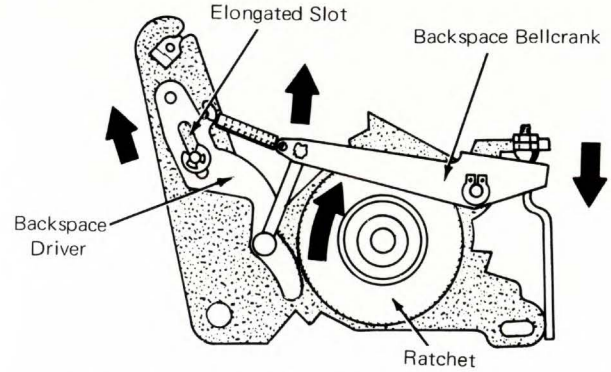


Figure 5 – Rotary Backspace Operated Position (Front View)

The amount of pull on the carrier return/backspace cable must be controlled to enable the rotary backspace to operate reliably in either 10 or 12 pitch. This is accomplished by a pitch cam which is mounted on the backspace driver mounting stud. A stud on the driver rests on top of the camming surface of the pitch cam. The driver stud resting on the low dwell or high dwell of the pitch cam controls the rest position (initial pivot point) of the driver. This determines at what point the driver engages the backspace ratchet. In the 10 pitch mode, the driver engages the ratchet at a lower point giving more rotary motion to the ratchet. In the 12 pitch mode, its pivot point is higher, therefore, engaging the ratchet at a higher point giving less motion. The position of the pitch cam is controlled by a cable connected to the switch pitch lever. (Fig. 6)

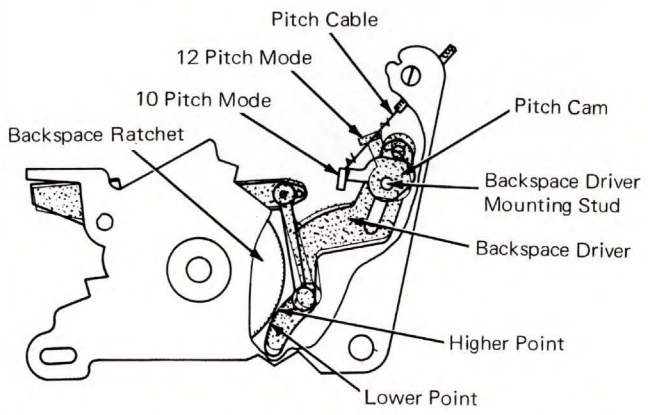


Figure 6 – Rotary Backspace Switch Pitch Operation (Rear View)

INDEX INTERLOCK

Since the rotary backspace mechanism uses the same cam and cam follower as carrier return and index, it is necessary to interlock the index mechanism during a backspace operation. The lower index link is connected at the bottom to the index multiplying lever. It is connected at the top by a stud in a slot in the index transfer bellcrank. The top of the link is spring loaded toward the front, therefore, its rest position is in the front of the slot. When carrier return or index is operated, the top of the link maintains its rest position in the slot and operates the index transfer bellcrank. (Fig. 7)

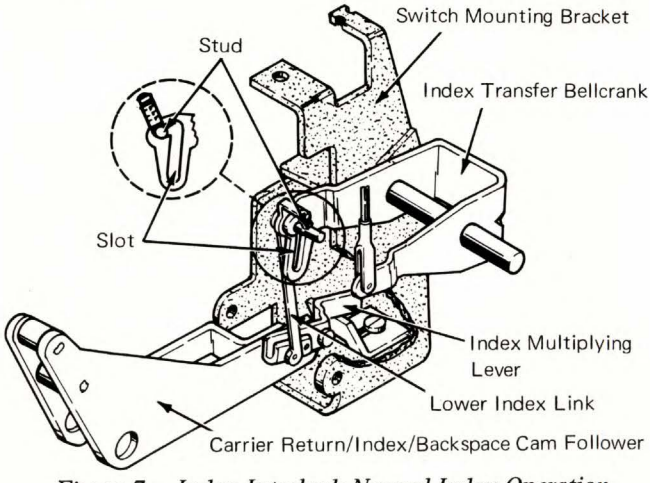


Figure 7 – Index Interlock Normal Index Operation (Right Front View)

The rearward motion of the backspace latch is used to operate the index interlock. An index interlock link connects the backspace latch to the index interlock bellcrank. The index interlock bellcrank is setscrewed to the index interlock shaft which pivots in the switch mounting bracket. A paddle on the end of the index interlock shaft is positioned directly in front of the stud on the top of the lower index link. When the backspace latch moves to the rear, the paddle moves the top of the lower index link to the rear of the slot. When the backspace is operated, the index multiplying lever is still operated, but the lower index link will move downward in the slot and the index transfer bellcrank will remain at rest. (Fig. 8)

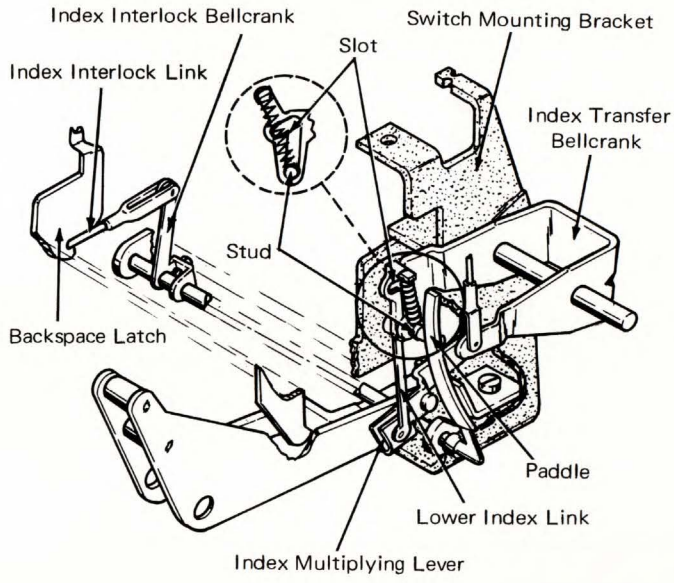
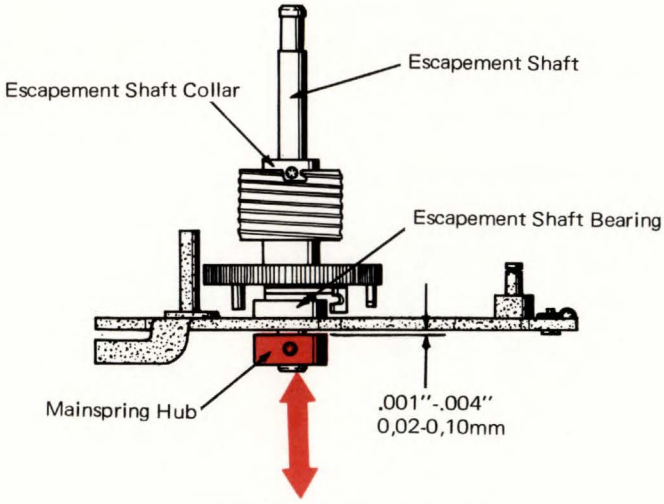
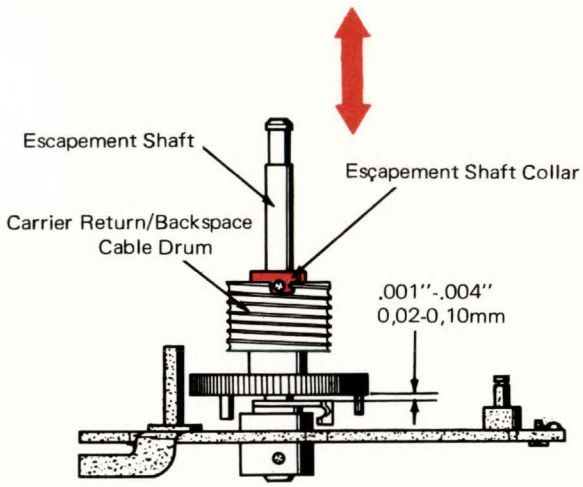


Figure 8 – Index Interlock Backspace Operation (Right Front View)

1. *Mainspring Hub* – Adjust the mainspring hub for .001"-.004" end play of the escapement shaft in the rear escapement bearing. This adjustment should be made with the escapement shaft collar loose.

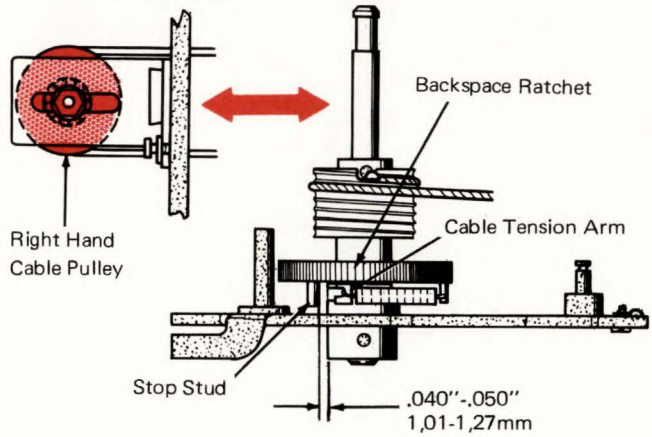


2. *Escapement Shaft Collar* – Adjust the escapement shaft collar for .001"-.004" end play of the carrier return/backspace cable drum on the escapement shaft.

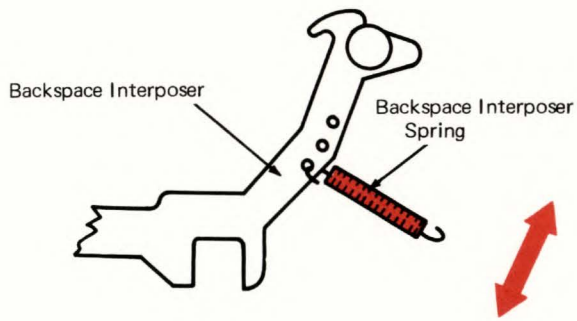


3. *Transport Cable Tension* – Adjust the right hand cable pulley left or right so the cable tension arm clears the stop stud on the backspace ratchet by .040"-.050".

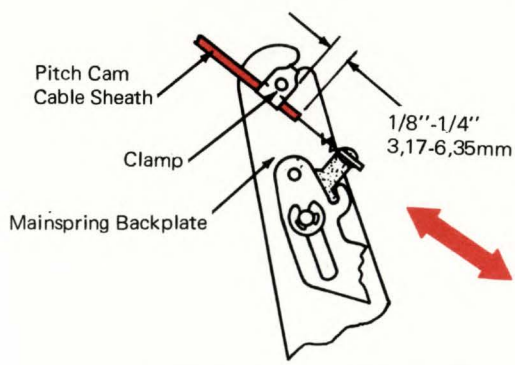
NOTE: If the right hand cable pulley reaches either extreme of its adjustment slot, the tab/escapement cable drum must be repositioned rotationally on the escapement shaft.



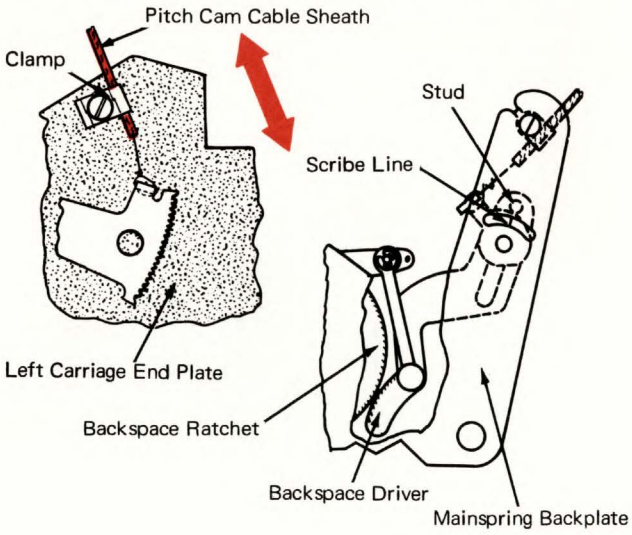
4. *Backspace Interposer Spring* – The backspace interposer spring must be in the bottom hole in the interposer.



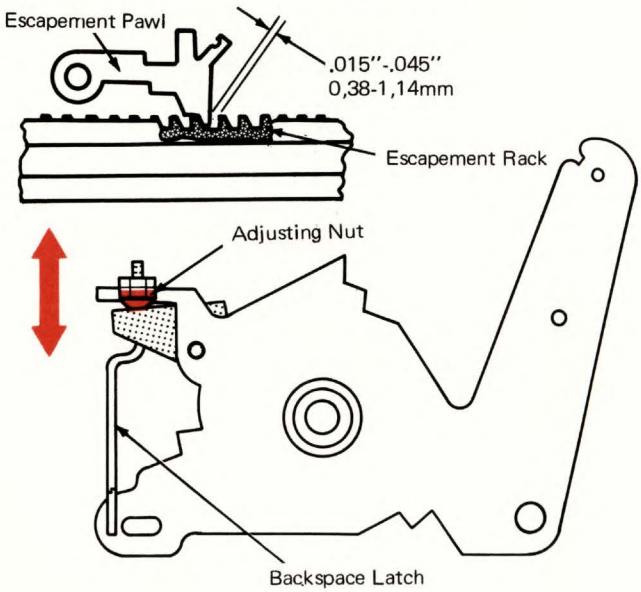
5. *Pitch Cam Cable Sheath* – The pitch cam cable sheath should extend 1/8 to 1/4 inch beyond the clamp on the mainspring backplate.



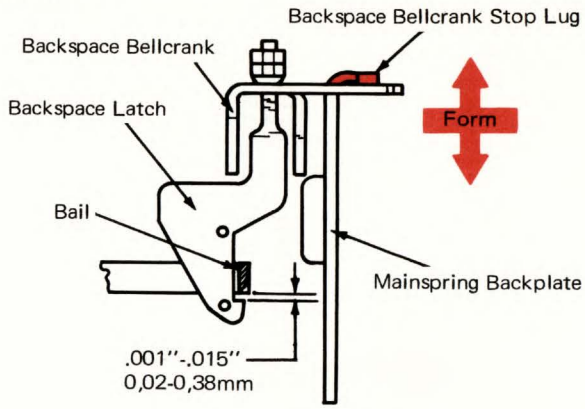
6. *Pitch Cam* – In the 12 pitch mode, hand cycle the backspace until the driver just seats in the ratchet. Adjust the pitch cam cable sheath on the left carriage end plate so the scribe line on the pitch cam lines up with the center of the stud on top of the backspace driver. Observe this condition through the notch in the paper feed center support and the hole in the backplate.



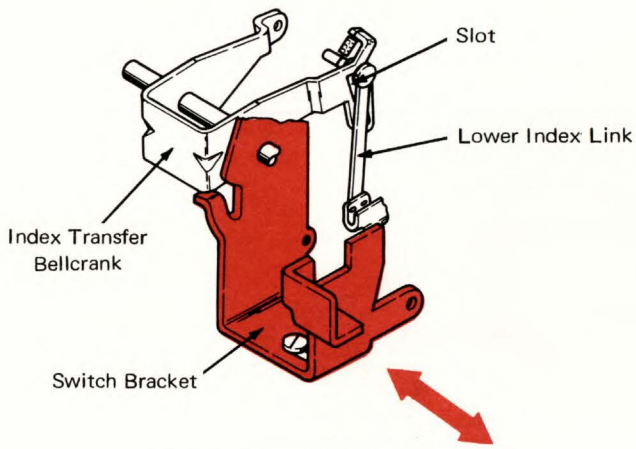
7. *Backspace Motion* – Place the machine in the 10 pitch mode and position the carrier approximately in the center of the writing line. Hand cycle 5 consecutive backspaces. Adjust the nut on top of the backspace latch so that all 5 backspaces travel an additional .015"-.045" after the escapement pawl drops into the next rack tooth. This must be checked for 5 backspaces because the motion at the carrier can vary as much as .020". You may need to manually place the latch beneath the cam follower to check this adjustment.



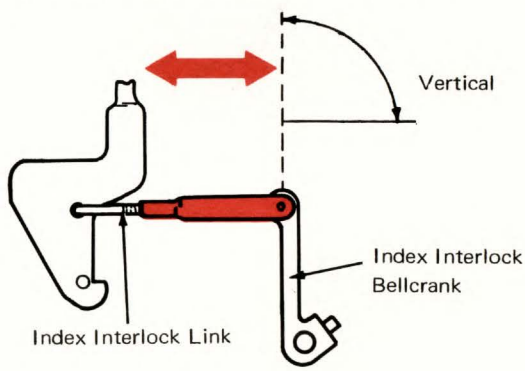
8. *Backspace Latch Height* – Form the backspace bellcrank stop lug on the mainspring backplate for .001"-.015" backspace latch clearance under the bail. After making this adjustment, check for some clearance between the backspace driver and the backspace ratchet with all parts at rest. If no clearance exists, refine the backspace motion and the backspace latch height adjustments.



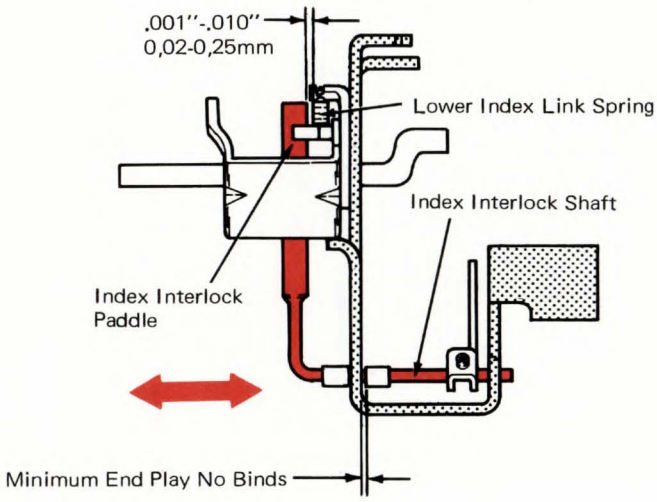
9. *Switch Bracket* – Adjust the switch bracket left or right to ensure that the lower index link does not bind in the slot in the index transfer bellcrank.



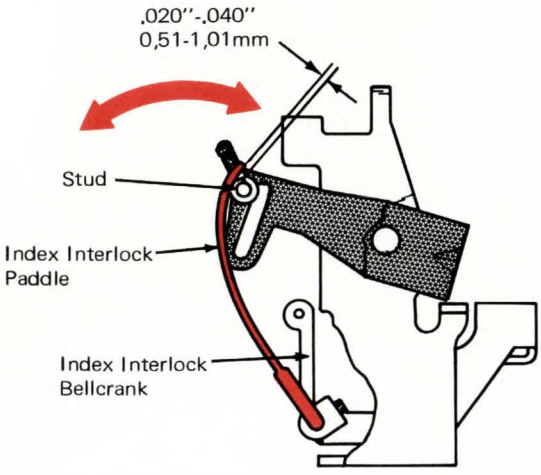
10. *Index Interlock Link* – Adjust the index interlock link so the index interlock bellcrank arm is vertical.



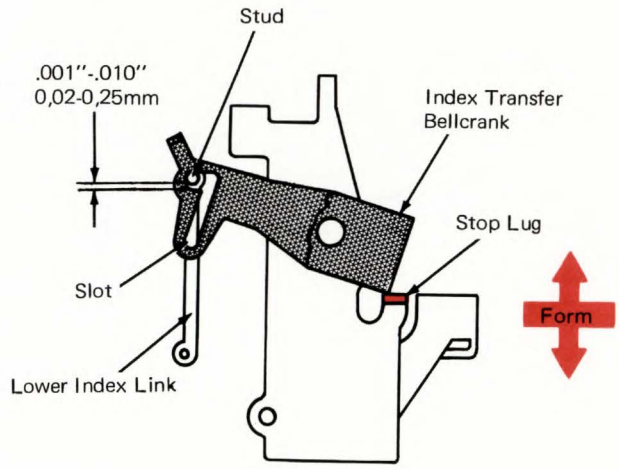
11. *Index Interlock Shaft* – Adjust the index interlock shaft left or right so the paddle clears the lower index link spring by .001"-.010". Check for interference with the escapement trigger upstop on 8X3's. Maintain minimum end play with no binds.



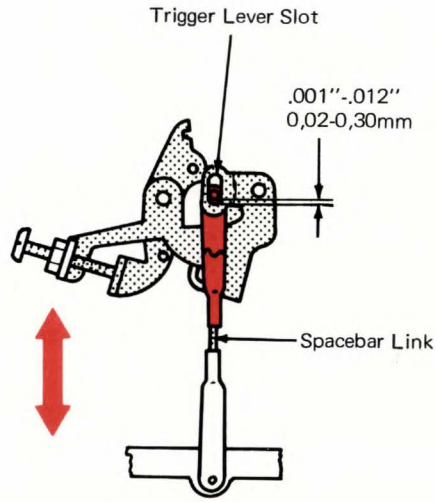
12. *Index Interlock Paddle* – Loosen the setscrew on the index interlock bellcrank. Adjust the paddle front to rear for .020"-.040" clearance to the stud on the lower index link. Position the bellcrank left or right to ensure the interlock link does not bind in the backspace latch or at the clevis.



13. *Index Transfer Bellcrank Stop Lug* – Form the index transfer bellcrank stop lug for a .001"-.010" clearance between the stud on the lower index link and the lower horizontal edge of the slot in the index transfer bellcrank. This will ensure that the lower index link stud reliably restores to the front of the slot after a backspace operation.



14. *Spacebar Link* – With the escapement trip link properly adjusted, adjust the spacebar link for .001"-.012" between the clevis pin and the bottom of the slot in the trigger lever.



The purpose of the express backspace mechanism is to enable the operator to move the carrier rapidly to the left from the keyboard. When the operator depresses the EXP keybutton the carrier will move to the left at the same speed as carrier return with the escapement pawl dragging. The carrier movement stops when the keybutton is released or the left margin is reached.

The express backspace bellcrank pivots on an extension of the operational cam check pawl shaft. The express backspace shoe is mounted on the left leg of the bellcrank which is positioned directly under the carrier return clutch spring. When the EXP keybutton is depressed, the keylever pawl moves downward and pushes on the right leg of the bellcrank. This causes the left leg to pivot upward and press the express backspace shoe against the carrier return clutch spring. The carrier return clutch spring drives the carrier return pinion moving the carrier to the left. (Fig. 1)

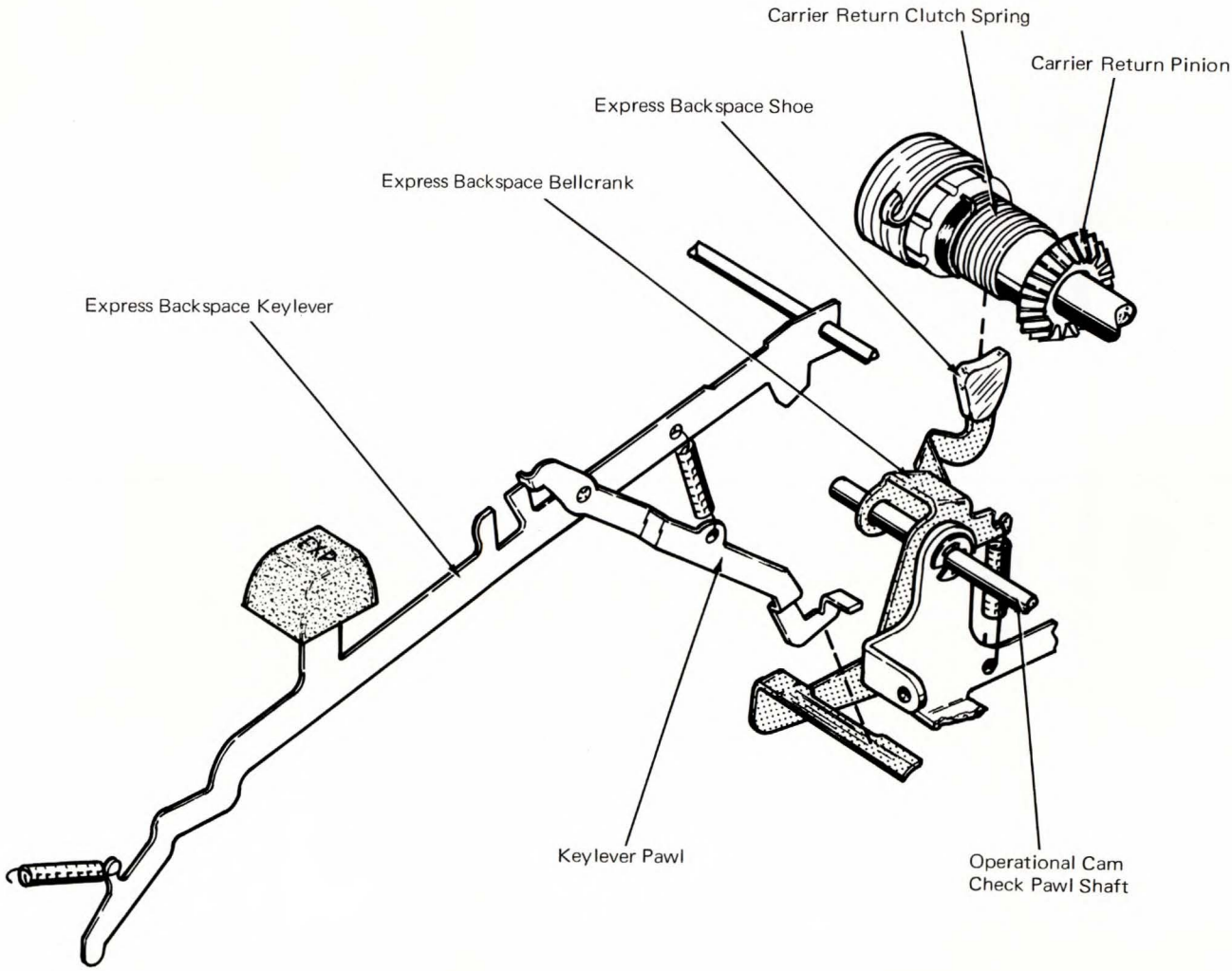


Figure 1 – Express Backspace Mechanism

On the single pitch "Selectric" II Typewriter, there would be a possibility of the carrier holding on the backspace pawl when the express backspace keybutton is released and the carrier stops. An additional part, called the express backspace latch, prevents this from happening by causing a backspace operation when the EXP keybutton is released. The express backspace latch is mounted on the operational keylever pawl guide. When the EXP key is depressed the express backspace keylever pawl rotates the express backspace latch which trips the backspace interposer. At the same time another extension of the latch moves behind a latching surface on the interposer and prevents it from traveling far enough to the rear to release the operational cam. When the EXP key is released, it allows the express backspace latch to restore upward, allowing the interposer to continue to the rear tripping a backspace operation. (Fig. 2)

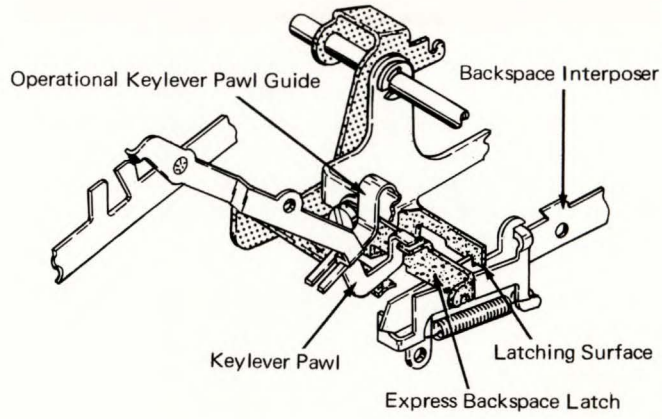
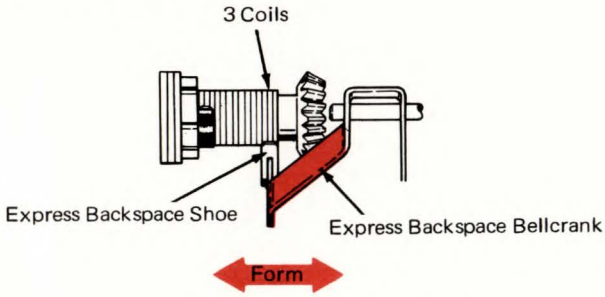


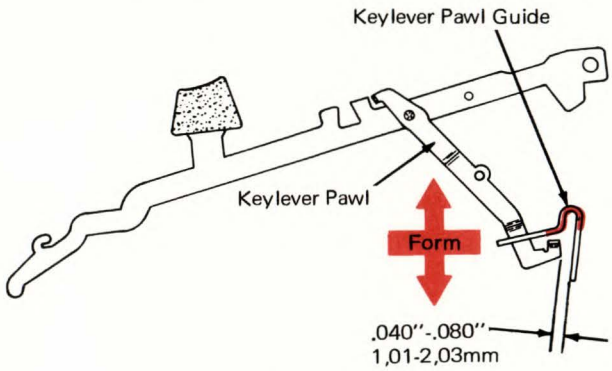
Figure 2 – Express Backspace (Single Pitch)

EXPRESS BACKSPACE ADJUSTMENTS

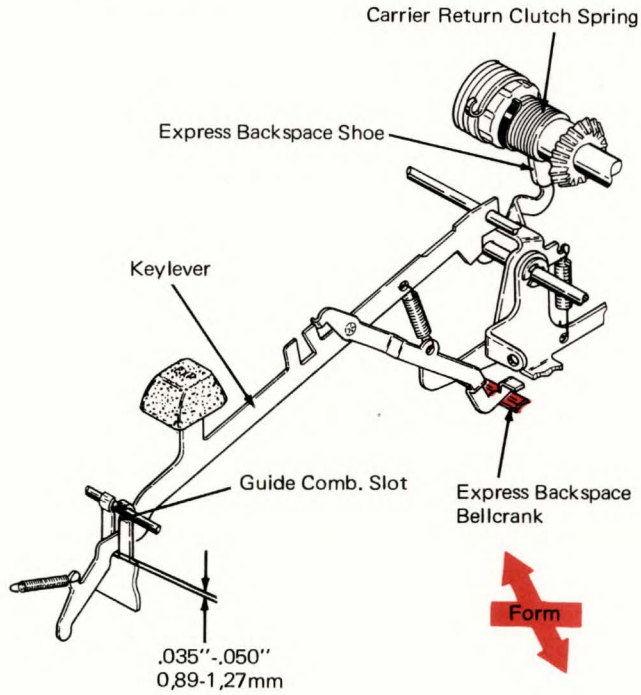
1. *Express Backspace Shoe Overlap* – Form the left arm of the express backspace bellcrank so the express backspace shoe overlaps three coils of the carrier return clutch spring.



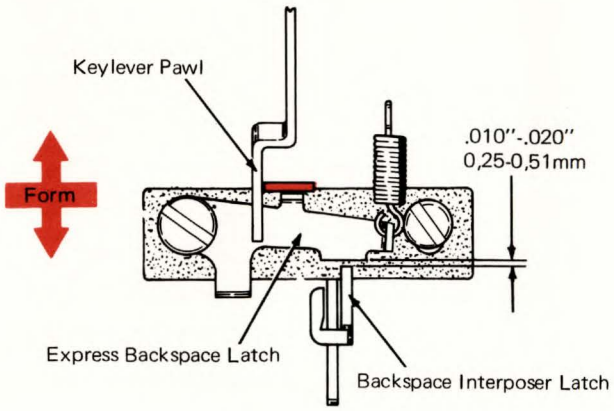
2. *Keylever Pawl Guide* – Form the keylever pawl guide finger so the tip of the express backspace keylever pawl clears the guide plate by .040"-.080".



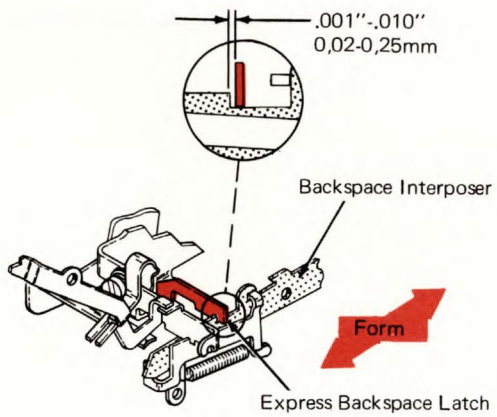
3. *Express Backspace Shoe Clearance* – Form the right lug on the express backspace bellcrank so the express backspace shoe engages the carrier return clutch spring when the keylever is .035"-.050" from the bottom of its guide comb slot.



4. *Keylever Pawl (single pitch only)* – Form the lug on the express backspace keylever pawl so there is .010"-.020" between the express backspace latch and the backspace interposer latch.



5. *Express Backspace Latch (single pitch only)* – Form the express backspace latch front to rear so the backspace interposer moves .001"-.010" to the rear when tripped by the latch.



The purpose of the Selective Ribbon system is to operate with either the film ribbon or the IBM Tech III ribbon. Both ribbons are contained in a cartridge similar in appearance to the "Selectric" Typewriter fabric ribbon cartridge, but considerably larger. The complete supply of ribbon is in the left side of the cartridge. The used ribbon will be wound around the take-up core on the right side and the cartridge will be discarded when the ribbon is used up. The cartridges for the two types of ribbons look the same but have different color take up knobs and leaders for identification; blue for IBM Tech III ribbon and cerise (pink) for film ribbon. (Fig. 1)

The feed modes for the two ribbons are completely different. The film ribbon must be fed so that no characters overlap whereas the IBM Tech III ribbon is fed in much smaller increments to use the overstrike capabilities of the ribbon. The inner construction of the cartridge determines in which ribbon feed mode the mechanism will operate.

A ribbon lift pattern of three tracks is used for both ribbons. However, the IBM Tech III ribbon lift is wobbled (varied) slightly to maintain even color.

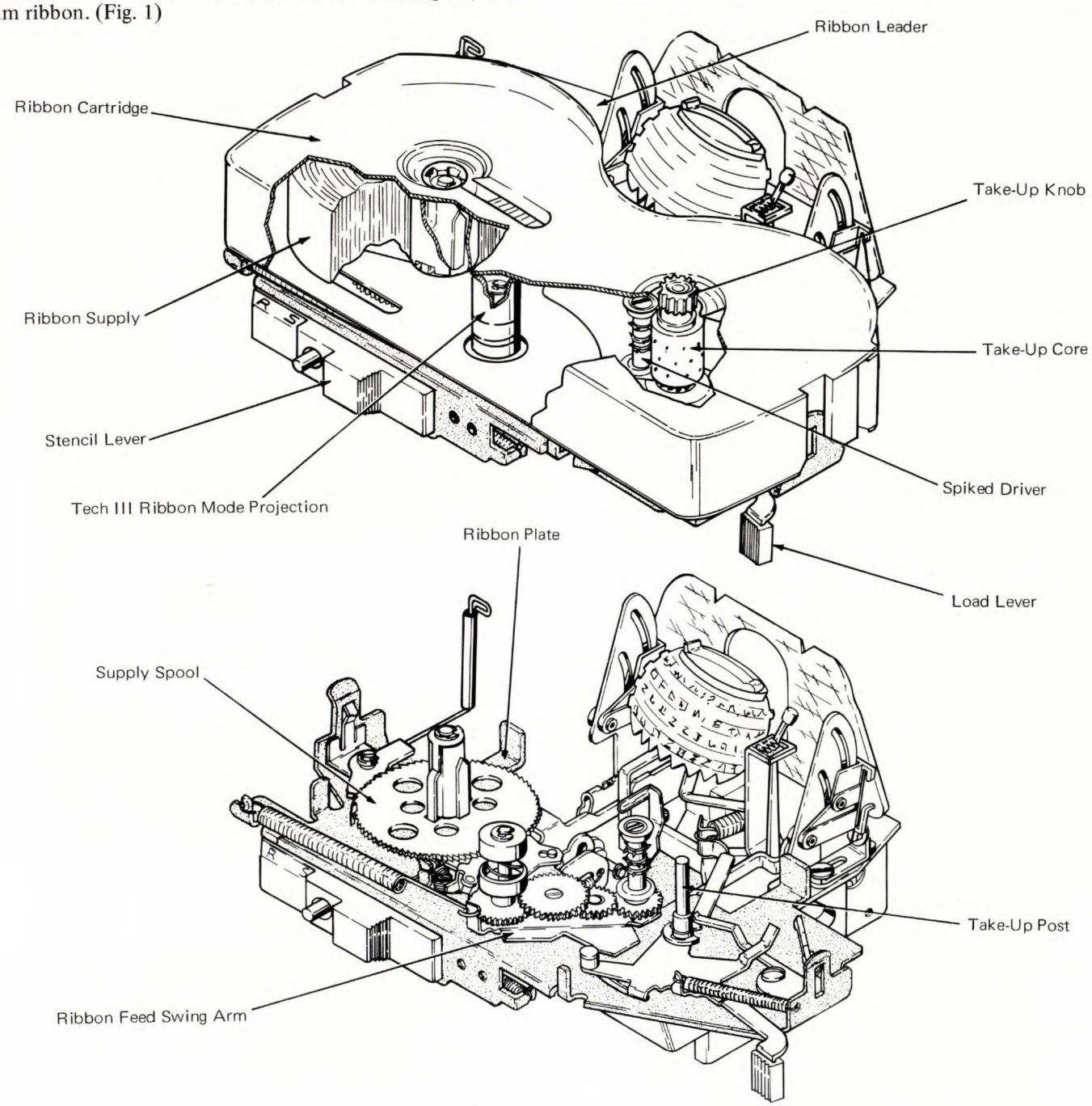


Figure 1 – Selective Ribbon System

RIBBON FEED

Ribbon feed is accomplished by the ribbon feed cam follower assembly operating a ribbon feed pawl. During a print cycle, the ribbon feed pawl operates in one of the eighteen feed windows on the ribbon feed and lift wheel, rotating it in a counterclockwise direction. At rest, the ribbon feed cam follower is on the high point of the ribbon feed cam and the ribbon feed pawl is engaged in one of the feed windows. (Fig. 2)

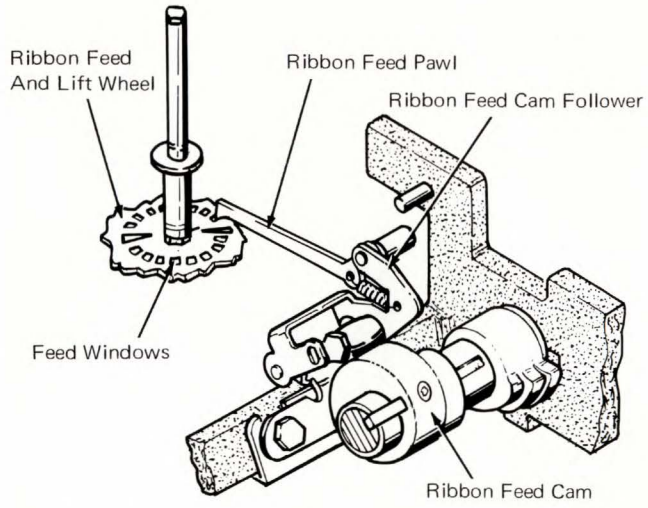


Figure 2 – Ribbon Feed At Rest (Right Rear View)

The ribbon feed cam follower is spring loaded against the ribbon feed cam. At the early stages of a print cycle, the cam follower moves toward the low dwell of the cam. The feed pawl moves toward the rear of the machine causing it to cam out of the window of the ribbon feed and lift wheel. As the cam follower approaches the low point of the cam, the pawl drops in the next window to the rear. The ribbon feed and lift wheel is held detented, preventing clockwise movement, by the ribbon lift control lever. (Fig. 3)

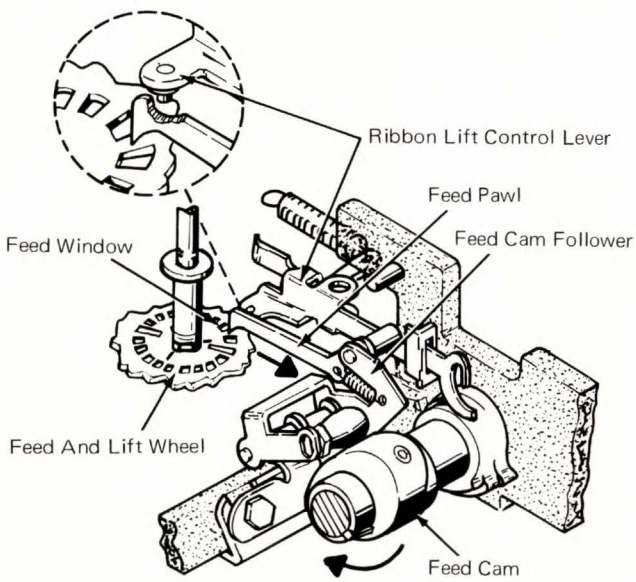


Figure 3 – Ribbon Feed, Early Stages Of Print Cycle

As the print cycle nears completion, the cam follower rises toward the high point of the cam moving the pawl toward the front of the machine. The pawl operates against the front surface of the window rotating the ribbon feed and lift wheel in a counterclockwise direction. (Fig. 4)

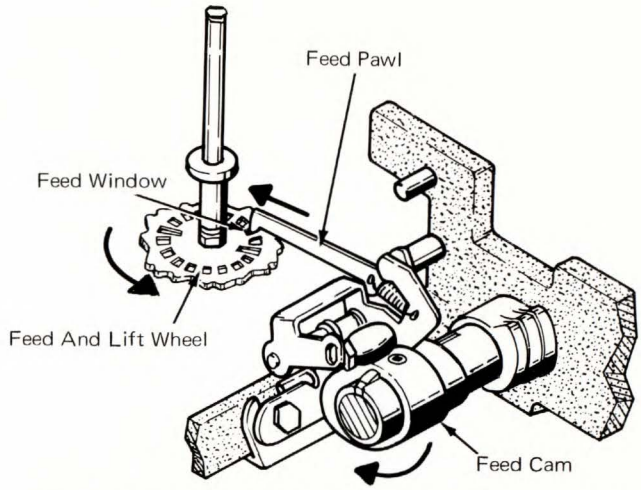


Figure 4 – Ribbon Feed, Print Cycle Near Completion (Right Rear View)

At the completion of the print cycle, the feed cam follower is again on the high point of the cam and the ribbon feed and lift wheel has been rotated 1/18 of a turn to its next detented position.

The ribbon feed and left wheel is connected to the ribbon feed post with a hex headed screw. The feed post is free to rotate within the ribbon feed swing arm. The ribbon feed swing arm pivots within a bearing in the ribbon plate. (Fig. 5)

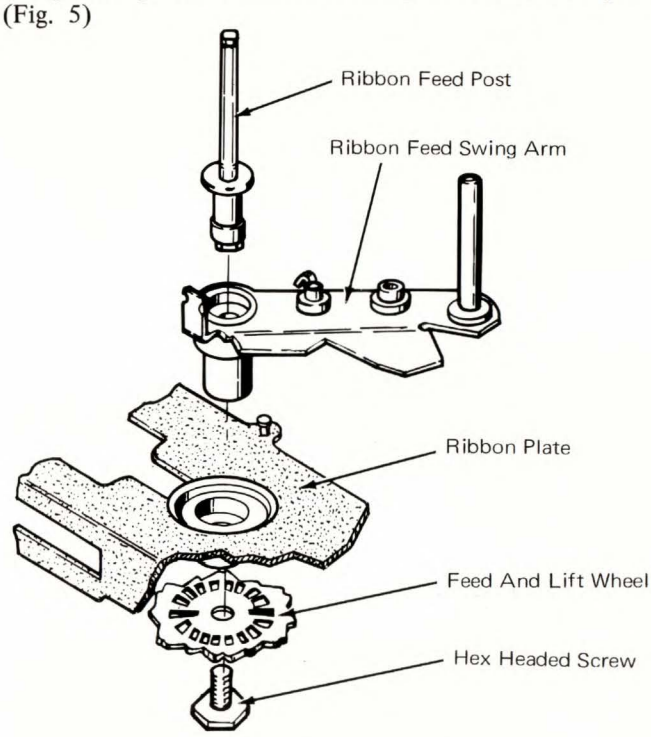


Figure 5 – Ribbon Feed Post And Swing Arm Mounting

The rotation of the ribbon feed and lift wheel rotates the ribbon feed post. The ribbon feed gear, mounted on flat surfaces of the feed post, also rotates. (Fig. 6)

The spiked driver is mounted on a post at the free end of the swing arm. Two intermediate gears mounted on the swing arm transfer the feed gear rotation to the spiked driver.

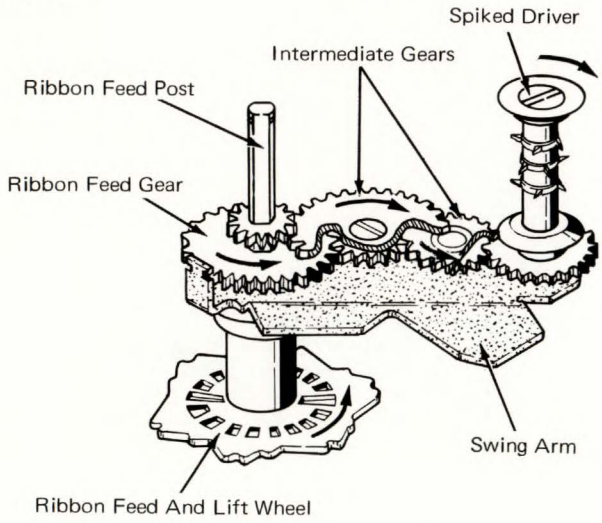


Figure 6 – Spiked Driver Rotation

The free end of the swing arm is heavily spring loaded toward the ribbon take-up post. This causes the spikes of the spiked driver to dig into the used ribbon. When the spiked driver rotates, it causes the take-up core to rotate about the take-up post pulling new ribbon into the print position and winding up the used ribbon. (Fig. 7)

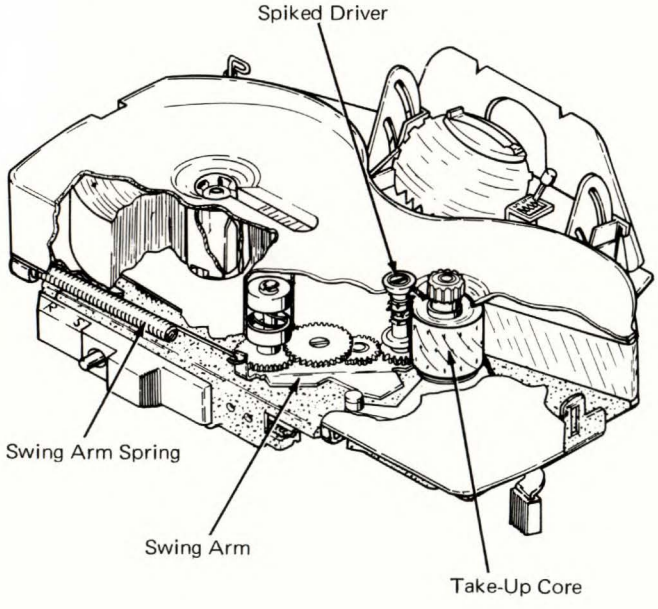


Figure 7 – Ribbon Feed Operation

The different feed increments for the two types of ribbon are controlled by the amount of spiked driver rotation for each print cycle.

The ribbon feed gear is free to slide vertically on the ribbon feed post. Its vertical position determines the amount of spiked driver rotation. In the film ribbon mode, the ribbon feed gear is spring loaded upward by the feed gear spring allowing its large gear to engage the small gear of the first intermediate gear. This causes the spiked driver to rotate a sufficient amount to feed film ribbon so the characters do not overlap. (Fig. 8)

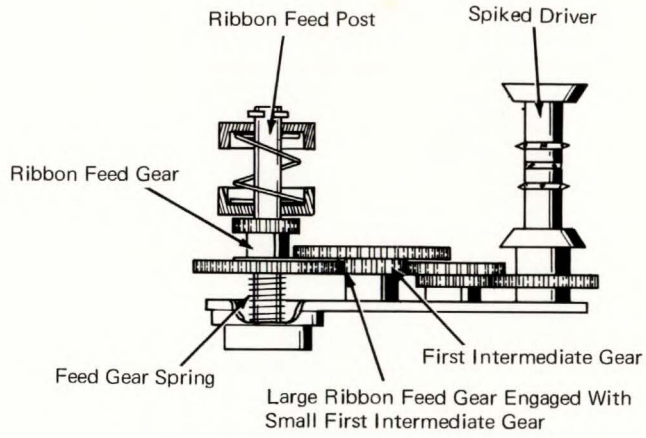


Figure 8 – Film Ribbon Mode

In the IBM Tech III ribbon mode, a projection within the cartridge depresses the ribbon mode button which, through a compression spring, depresses and holds down the ribbon feed gear. This allows the small gear on the ribbon feed gear to engage the large gear of the first intermediate gear and causes the spiked driver to rotate approximately 1/6 the amount as in the film ribbon mode. (Fig. 9)

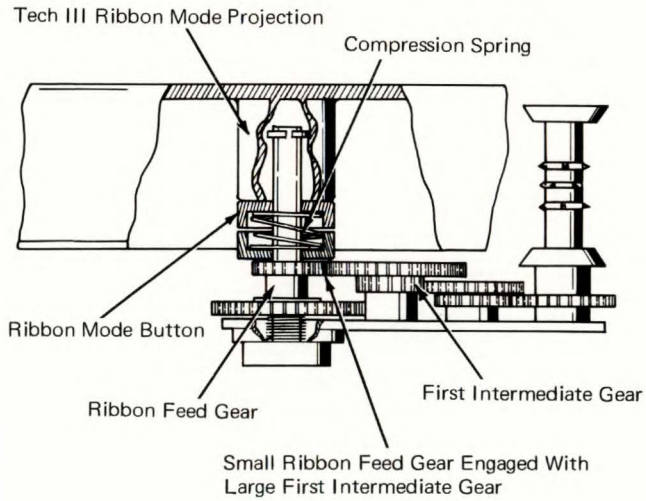


Figure 9 – IBM Tech III Ribbon Mode

The ribbon must be kept slightly taut throughout the ribbon path for proper feed and tracking. This is accomplished by the ribbon shock wire detenting the ribbon supply spool. The ribbon supply spool is not allowed to rotate until the ribbon applies sufficient tension on the shock wire to release the detent. As fresh ribbon is supplied, some tension is released from the shock wire allowing the detent to reseat in the teeth of the supply spool. (Fig. 10)

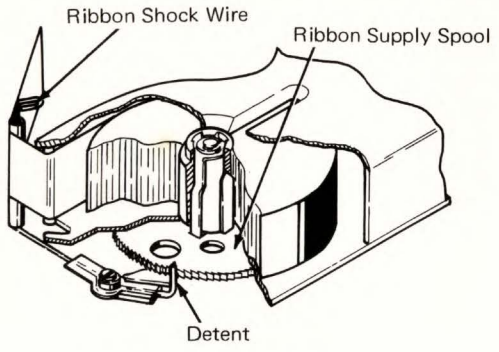


Figure 10 – Ribbon Tension System

RIBBON LIFT

Both types of ribbons used with this mechanism are slightly less than 11/16 inch wide. In order to get the maximum character yield, the mechanism will use three different ribbon lift positions. The ribbon lift mechanism includes a lift cam, lift cam follower assembly, lift control lever, lift arm and lift guide assemblies. (Fig. 11)

The lift cam follower pivots above and to the rear of the lift cam. A lift spread adjusting plate is mounted to the cam follower by two small screws. A lug on the adjusting plate contacts the head of the height adjusting screw in the lift arm. As the cam follower is pivoted by the lift cam it supplies vertical motion to the lift arm.

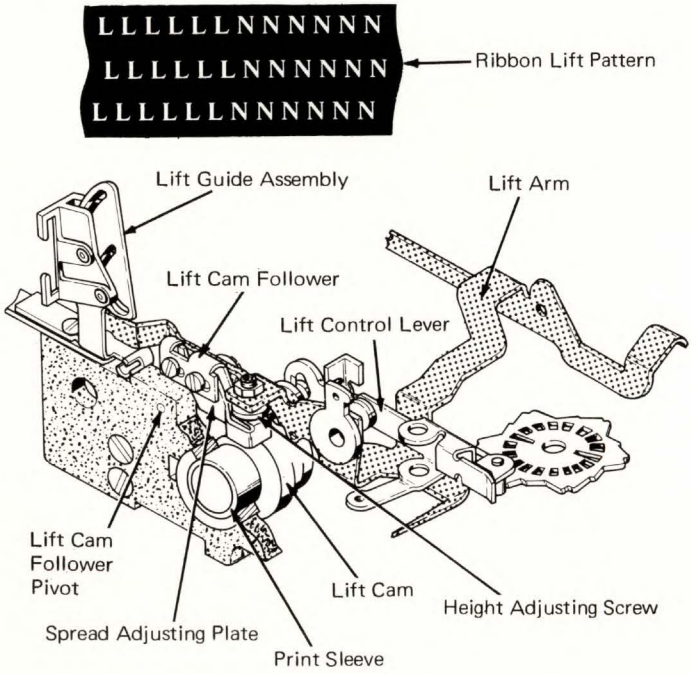


Figure 11 – Ribbon Lift Mechanism

The ribbon is threaded through the ribbon lift guides which have the ability to move vertically in curved slots in the lift guide brackets. The lift guides are connected to the lift arms by the lift guide links which are a part of the lift guide assemblies. The lift arms and lift guides are biased together by the lift guide bias springs to prevent erratic ribbon lift. (Fig. 12)

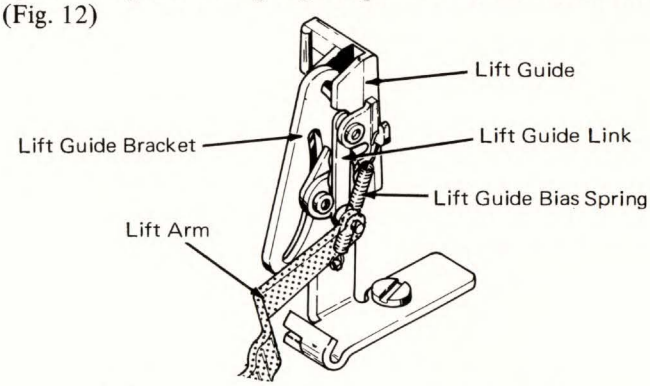


Figure 12 – Ribbon Lift Guide Assembly

The three ribbon lift positions are determined by the lift cam which has three different height lobes. The amount of motion that the lift cam follower receives depends on which of the three lobes is used. (Fig. 13)

The ribbon lift cam follower roller is free to slide on its shaft. Its lateral position is controlled by a yoke on the ribbon lift control lever. A stud on the forward end of the ribbon lift control lever is spring loaded against the camming surface of the ribbon feed and lift wheel.

The ribbon feed and lift wheel camming surface has three different heights. As the forward end of the ribbon lift control lever follows the feed and lift wheel camming surface, the yoke on the rear end of the ribbon lift control lever positions the ribbon lift cam follower roller over one of the three lobes of the ribbon lift cam. This changes the ribbon lift from high lift to medium lift to low lift and back to high lift again to repeat the cycle.

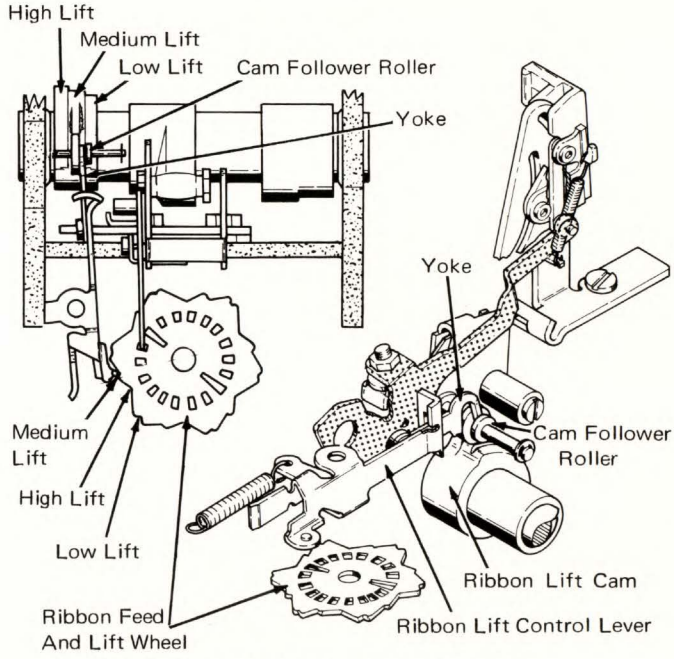


Figure 13 – Ribbon Lift Operation

In the IBM Tech III ribbon mode, the ribbon lift pattern is "wobbled" or varied slightly to ensure even print color. This is accomplished by the wobbler cam, the wobbler bellcrank and the wobbler eccentric. The left pivot point of the ribbon lift arm assembly is the wobbler eccentric. The wobbler eccentric has an upright lug that extends above the surface of the ribbon plate. Moving this lug front to rear causes the wobbler eccentric to rotate, moving the left lift arm pivot point up or down. (Fig. 14)

The wobbler bellcrank pivots on a stud on the ribbon plate just to the left rear of the ribbon feed gear. The tip of the left wobbler bellcrank arm rests in a cutout in the upright lug of the wobbler eccentric. The wobbler eccentric spring loads both the wobbler eccentric lug and the wobbler bellcrank arm toward the front. If the mechanism is in the IBM Tech III ribbon mode, the wobbler bellcrank arm moves front to rear moving the wobbler eccentric lug front to rear.

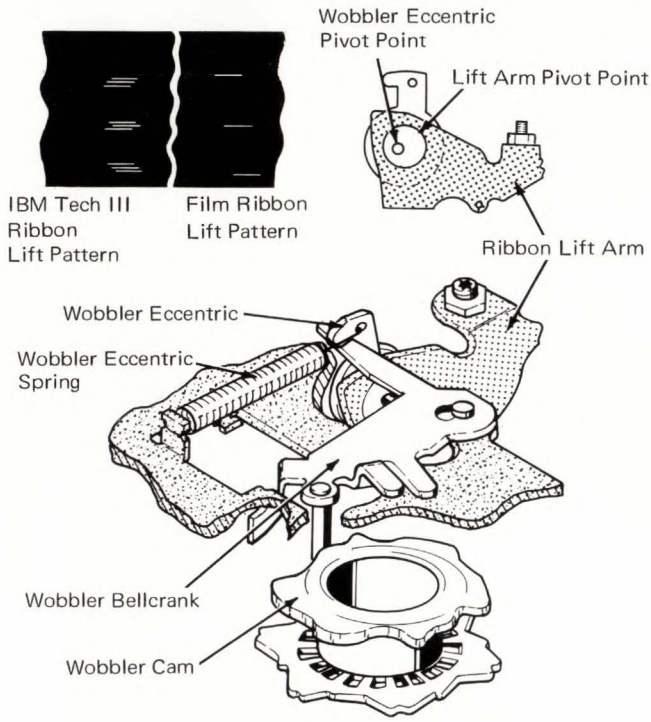


Figure 14 – Ribbon Lift Wobble Mechanism

The wobbler mechanism is active only in the IBM Tech III ribbon mode. The front of the wobbler bellcrank is free to move vertically. Its vertical position is controlled by two lugs on the wobbler bellcrank contacting the ribbon feed gear. When the feed gear is pressed down into the IBM Tech III ribbon mode by the cartridge, it also moves the wobbler bellcrank down into the operated position. When the wobbler bellcrank is in the operated position, a stud on the forward end of it follows the wobbler cam which is mounted directly above and turns with the ribbon feed and lift wheel. The motion from the wobbler cam rotates the wobbler bellcrank which operates the wobbler eccentric causing the desired variation in the ribbon lift pattern. (Fig. 15)

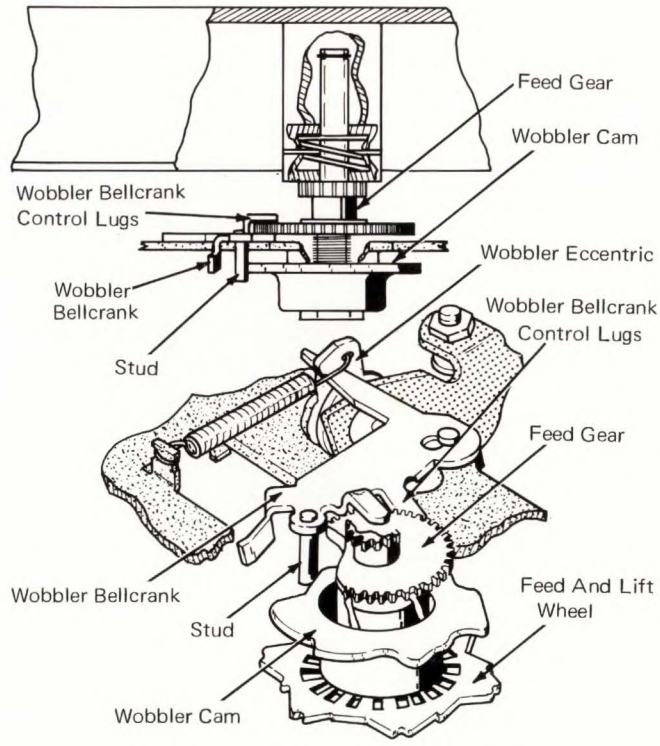


Figure 15 – IBM Tech III Mode – Wobbler Active

When the mechanism is in the film ribbon mode, the feed gear is up. This allows a lug on the wobbler bellcrank to be latched against the ribbon plate causing the bellcrank to be inactive. (Fig. 16)

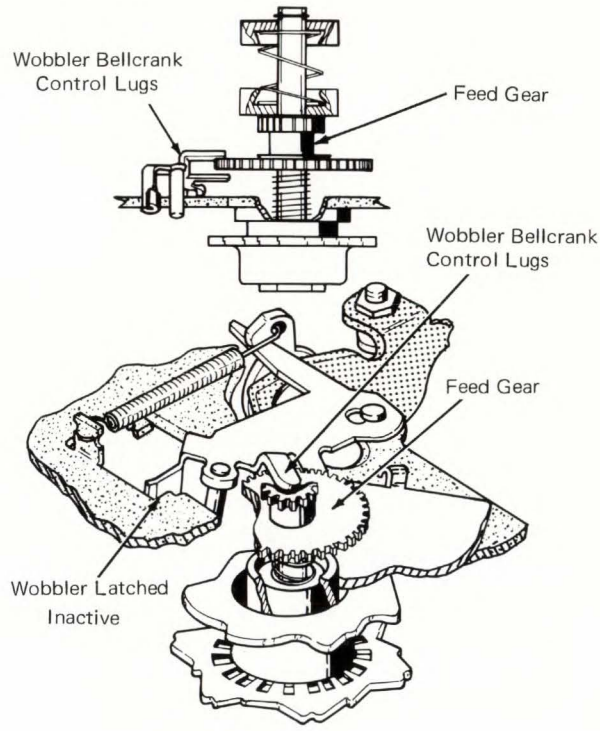


Figure 16 – Film Mode – Wobbler Inactive

STENCIL MODE

When the typewriter is used for typing stencils, the ribbon feed and lift operations must be locked out. This is achieved by moving the stencil lever left to the stencil position. The lever will latch in the stencil position and can be released by pushing the release button. A lug on the stencil lever contacts an extension on the front of the lift control lever moving the rear of the lift control lever to the right. This moves the lift cam follower roller completely off the lift cam, inhibiting ribbon lift. (Fig. 17)

When the lift control lever is in the stencil position, a feed lockout lug on it moves behind the feed pawl mounting stud. This prevents rearward movement of the feed pawl, inhibiting ribbon feed.

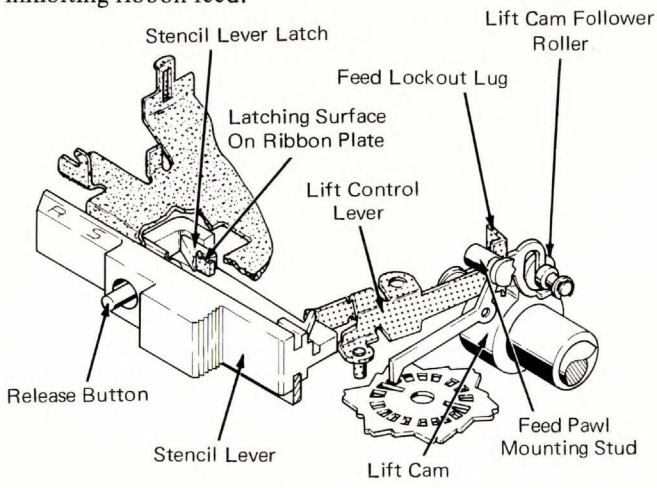


Figure 17 – Stencil Operation

RIBBON LOAD

When the ribbon needs to be changed the load lever is moved to the left to the load position. An inclined surface on the underside of the load lever contacts a lug on the right front of the lift arm assembly. This cams the front of the lift arm down and raises the lift guides for easier ribbon installation. (Fig. 18)

During the loading of a ribbon, the operator must be prevented from turning the take-up core in the wrong direction. A spring finger extends to the left from the right cartridge retaining spring. This is called the take-up core interlock. The tip of the take-up core interlock is formed up just to the rear of the take-up post. In the load position, the take-up core interlock engages the teeth on the take-up core preventing it from being rotated in a clockwise direction. In the normal operating position, the take-up core interlock is held down, disengaged from the take-up core, by a lug on the load lever.

The load lever latch is just to the rear of the right cartridge retaining spring. This latch will not allow the load lever to restore to the operate position until a cartridge is installed, depressing and releasing it.

A stud and roller on the left of the load lever contacts the right side of the swing arm. As the load lever rotates, it rotates the swing arm to the load position. The load lever detents on a flat surface on the swing arm.

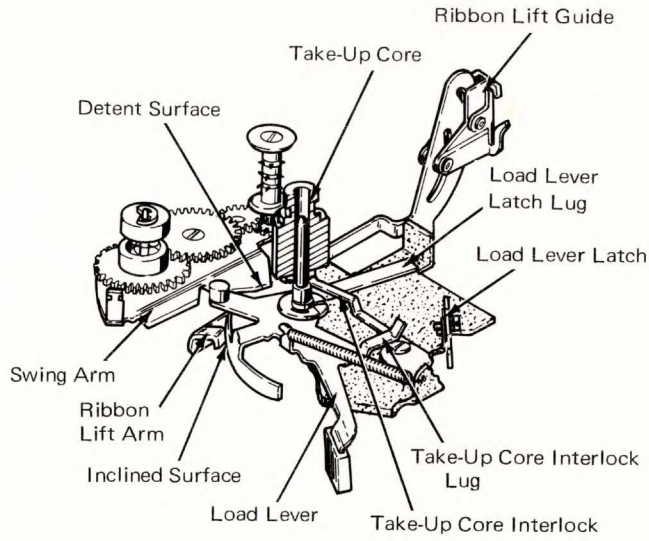


Figure 18 – Load Lever Operation

As the swing arm moves to the load position, it contacts the wobbler bellcrank rotating it clockwise. This positions the wobbler bellcrank so that when it restores, it will reliably latch against the ribbon plate in the film ribbon mode or easily move down into the operated position in the IBM Tech III ribbon mode. (Fig. 19)

As the wobbler bellcrank rotates, its left arm moves the upright lug of the wobbler eccentric to the rear. The wobbler eccentric lug contacts the right arm of the shock wire disengage lever which pivots on the supply spool post. The left arm of the shock wire disengage lever rides a camming surface of the shock wire. As the left arm moves to the front, it cams the shock wire detent from the ribbon supply spool. This action is necessary to enable the operator to easily wind the leader on to the take-up core when installing a ribbon.

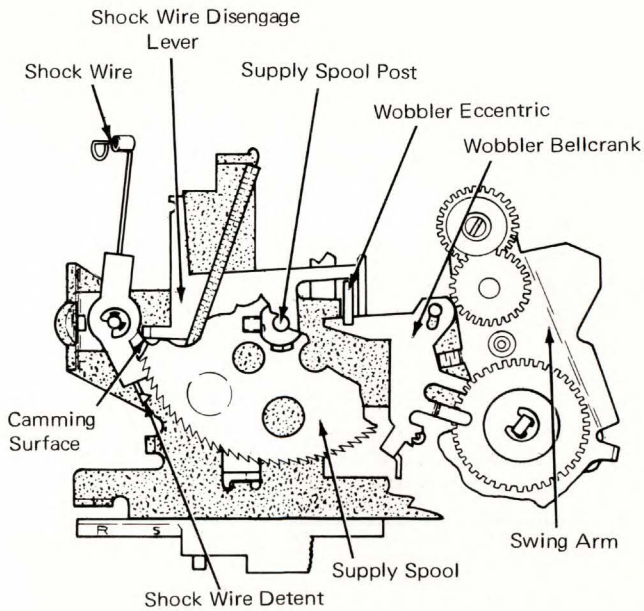
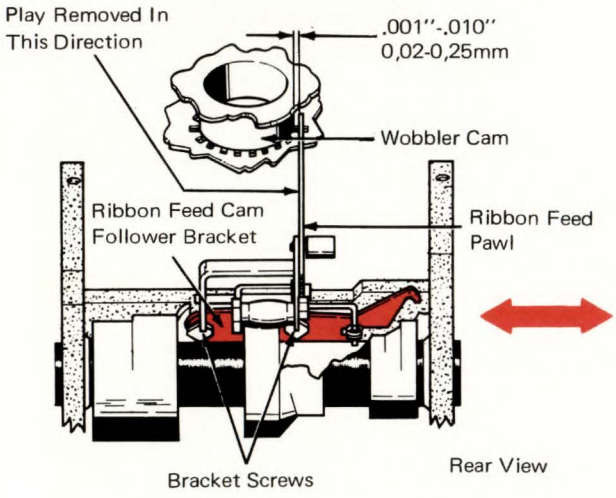


Figure 19 – Load Operation – Wobbler Release – Shock Wire Disengage

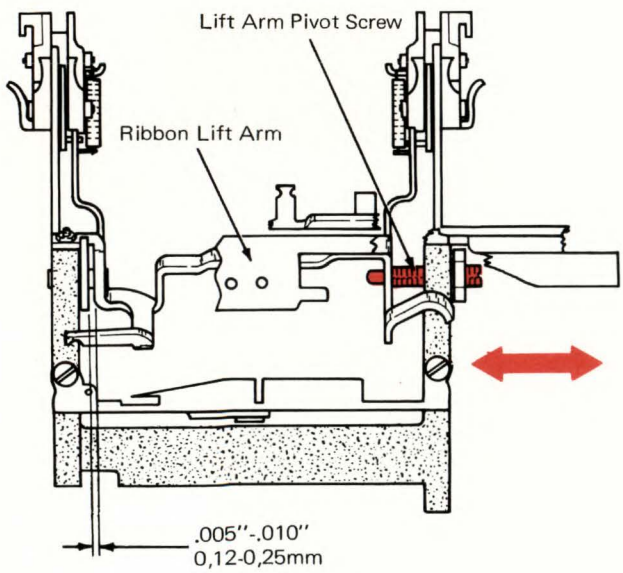
1. *Ribbon Feed Cam Follower Bracket* – Adjust the ribbon feed cam follower bracket left or right so the ribbon feed pawl is .001"-.010" from the wobbler cam at the closest point, with the play in the ribbon feed pawl held away from the wobbler cam.

   This adjustment will ensure that the feed pawl will not bind against the wobbler cam and will not move beyond the outside limits of the feed window.

   The bracket screws can be made accessible from the top by removing the ribbon plate and feed cam follower assembly or from underneath by removing one of the cable anchor bracket screws and pivoting the cable anchor out of the way.



2. *Ribbon Lift Arm* – Adjust the right hand lift arm pivot screw for .005"-.010" end play of the lift arm. Make this adjustment with the wobbler eccentric lug in an upright position.

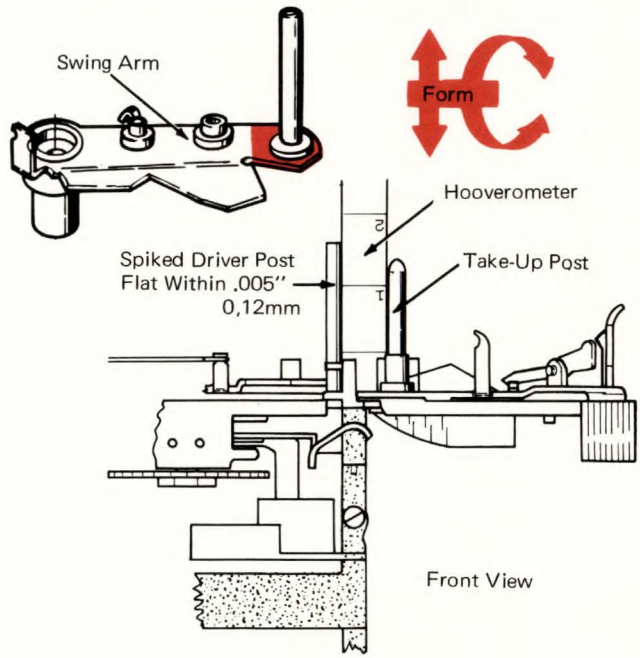


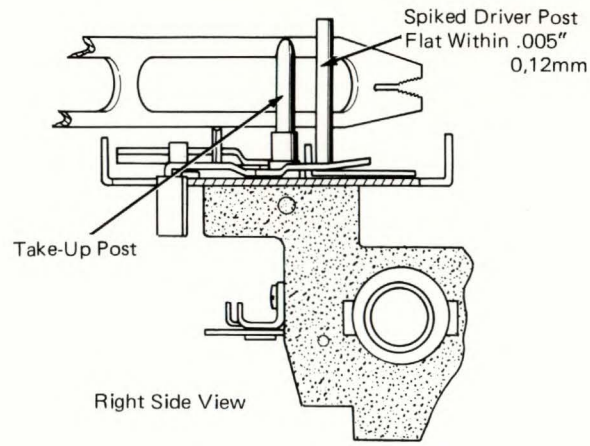
3. *Spiked Driver Post* – The spiked driver post must be parallel to the take-up post within .005". This must be checked in two ways, with the swing arm spring connected.

   a. Hold the Hooverometer edge flat against the take-up post. Allow the swing arm to close until the spiked driver post contacts the other edge of the Hooverometer. The spiked driver post should be flat to the Hooverometer edge within .005".

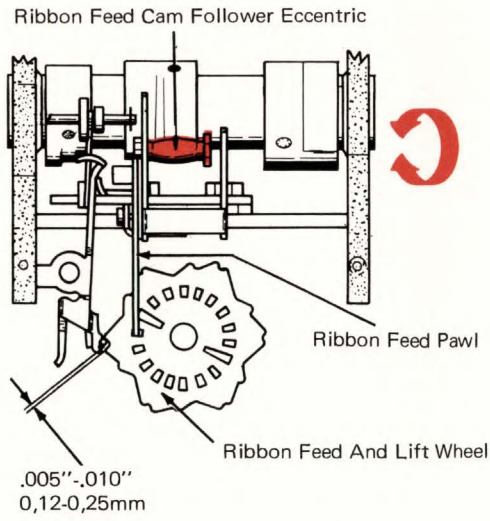
   b. Place a flat surface (such as an aligning wrench) against the take-up post and spiked driver post. The posts should both be flat to the surface within .005".

   Form the free end of the swing arm to obtain these conditions. The symptom of an out of parallel condition will be a bind within the cartridge caused by the used ribbon coning. This could cause feed failures.

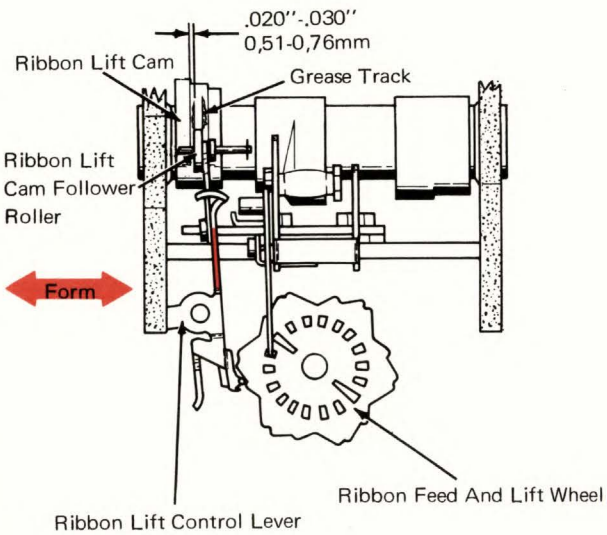




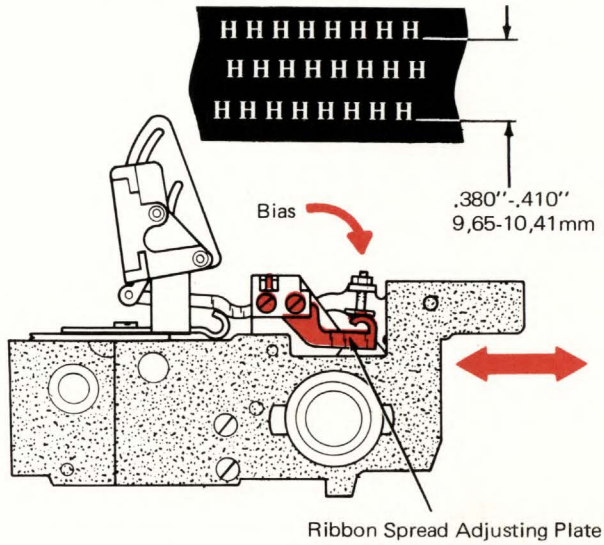
4. *Ribbon Feed Cam Follower Eccentric* – Adjust the ribbon feed cam follower eccentric to cause the ribbon feed pawl to drive the ribbon feed and lift wheel .005"-.010" past the detented position on a high lobe of the ribbon feed and lift wheel camming surface. Keep the eccentric in the lower front half of its orbit.



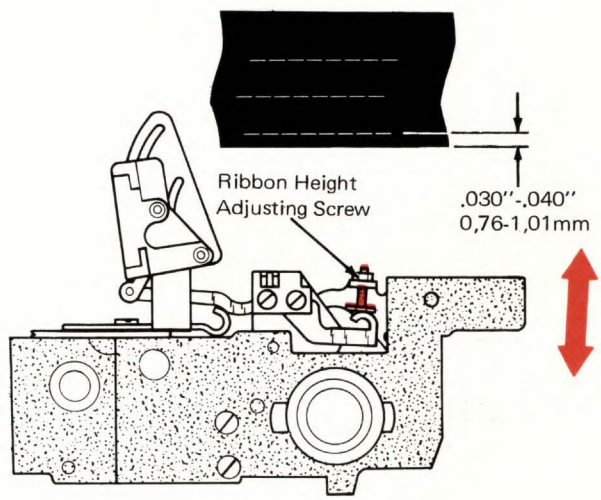
5. *Ribbon Lift Control Lever* – Position the ribbon feed and lift wheel detented in the medium lift position (middle lobe). Form the ribbon lift control lever to position the left edge of the ribbon lift cam follower roller .020"-.030" from the edge of the high lift lobe. This may also be observed dynamically by putting fresh grease on the ribbon lift cam and observing the roller track in the grease on the medium lift lobe.



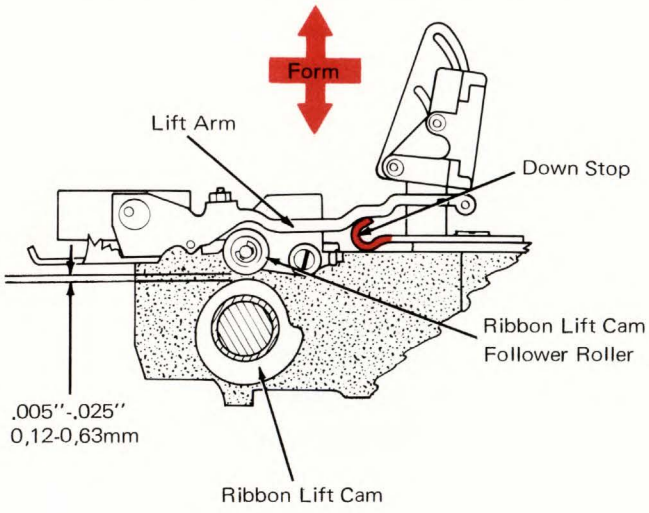
6. *Ribbon Spread Adjusting Plate* – In the film ribbon mode, adjust the ribbon spread adjusting plate front to rear to obtain .380"-.410" from the bottom of a high lift character to the bottom of a low lift character. This may be measured with the aid of the 6 inch steel rule or the Hooverometer handle which is .375" wide. The ribbon spread adjusting plate must be biased in a clockwise direction as viewed from the left side of the carrier when tightening the binding screws. This is easily accomplished by tightening the screws with the machine half cycled. This takes out the play in the mounting holes in the direction of the lifting force and ensures that the adjustment does not change. Ribbon height must be checked after making this adjustment.



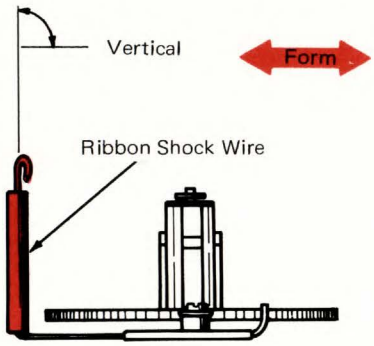
7. *Ribbon Lift Height* – In the film ribbon mode, adjust the ribbon height adjusting screw so the bottom edge of the underscore clears the bottom of the ribbon by .030"-.040". Ribbon spread must be checked after making this adjustment.



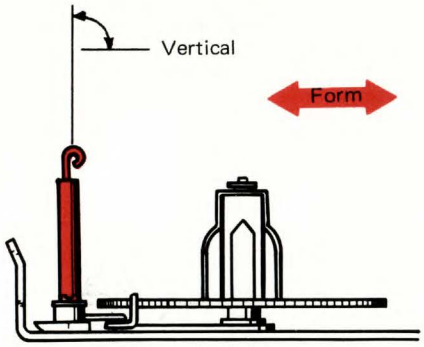
8. *Ribbon Lift Arm Lower Stop* – Form the left ribbon lift arm down stop so the ribbon lift cam follower roller clears the ribbon lift cam by .005"-.025" at rest. This ensures free left to right movement of the roller.



9. *Ribbon Shock Wire* – Form the shock wire to be vertical front to rear and left to right. This adjustment may need to be refined for proper ribbon tracking through the left ribbon lift guide.



Left Side View



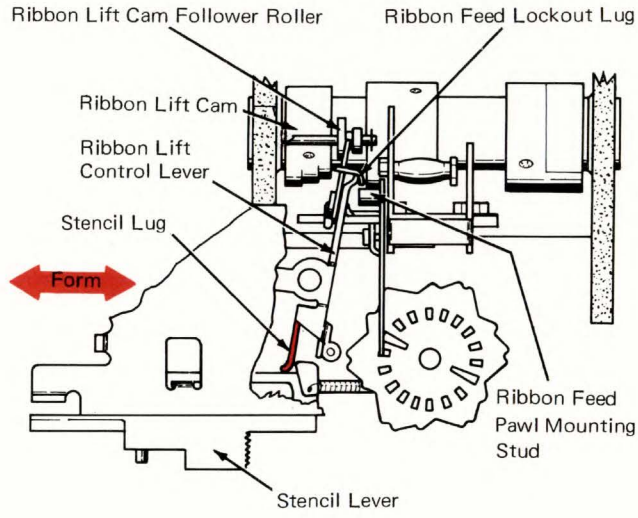
Front View

10. *Stencil Adjustment* – Form the stencil lug on the ribbon lift control lever to meet two conditions when the stencil lever is latched in the stencil position.

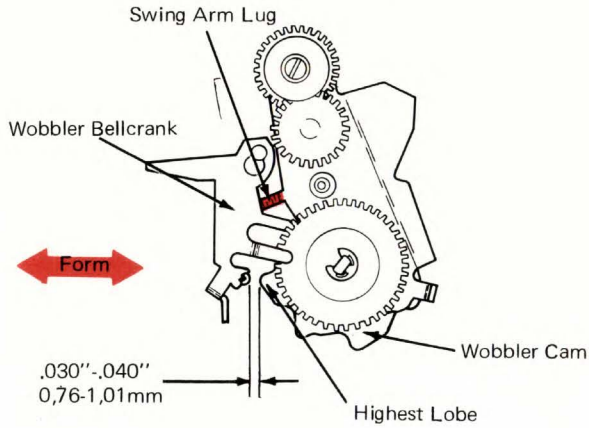
a. The ribbon feed lockout lug must engage the ribbon feed pawl mounting stud by approximately the thickness of the lockout lug.

b. The ribbon lift cam follower roller must be moved to the right, completely off the ribbon lift cam, but still have some clearance between the roller and the C-clip at the end of its shaft.

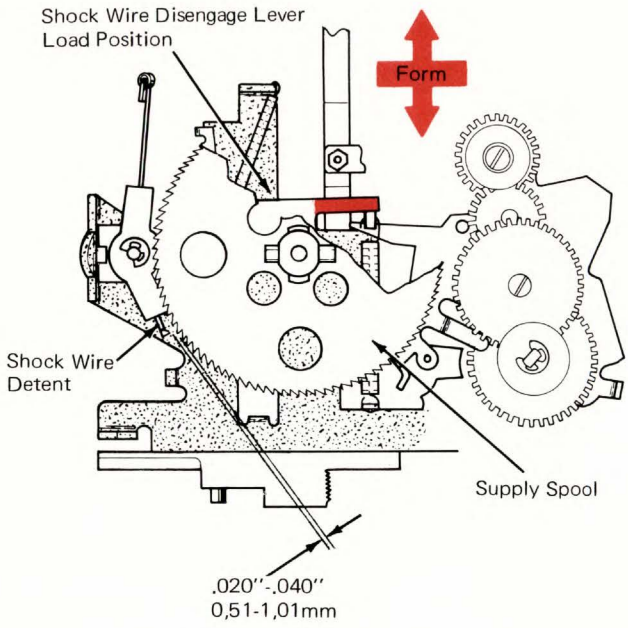
NOTE: During normal typing, in the low lift ribbon position, the ribbon feed lockout lug on the ribbon lift control lever must clear the ribbon feed pawl mounting stud. If necessary, form the ribbon feed lockout lug to obtain this condition. If the lug is formed, re-check the stencil adjustments.



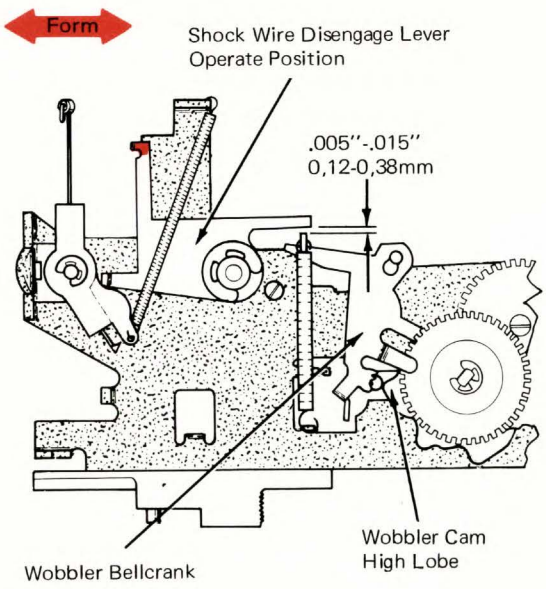
11. *Swing Arm Lug* – Form the lug on the swing arm that contacts the wobbler bellcrank so the cam follower stud on the wobbler bellcrank clears the high lobe of the wobbler cam by .030"-.040" when the load lever is detented in the load position. The high lobes of the wobbler cam are marked.



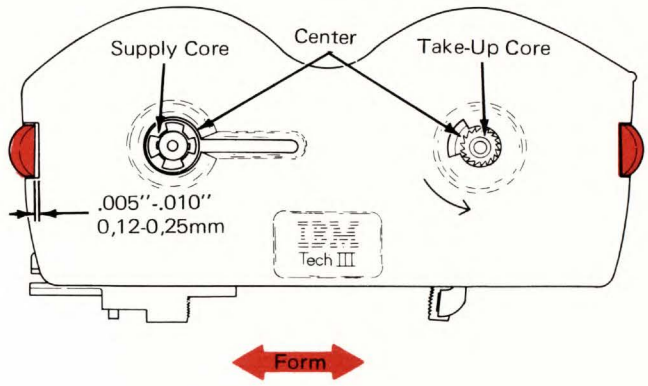
12. *Shock Wire Disengage Lever (Load Position)* – Form the right hand arm on the shock wire disengage lever so the shock wire detent clears the ribbon supply spool by .020"-.040" when the load lever is in the load position. Ensure that the wobbler eccentric lug cannot get under the arm. If necessary, form the arm down.



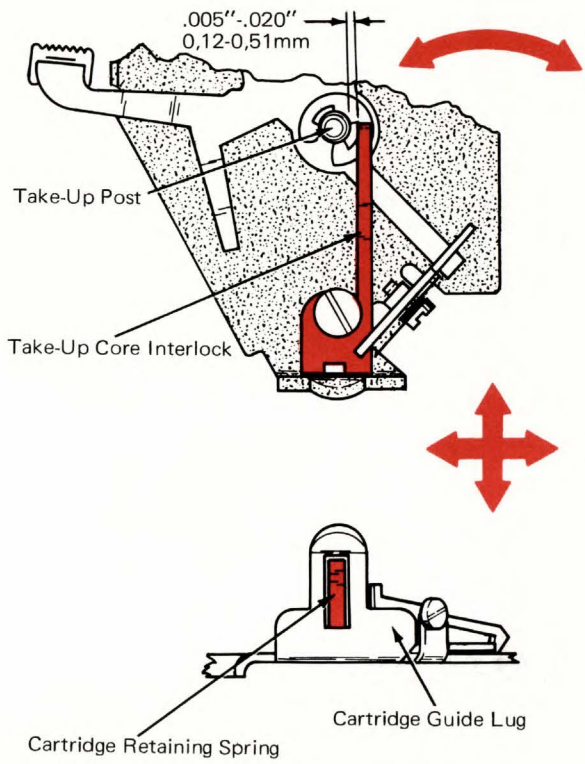
13. *Shock Wire Disengage Lever (Operate Position)* – In the IBM Tech III ribbon mode, form the shock wire disengage lever rest position lug so the shock wire disengage lever arm clears the wobbler eccentric by .005"-.015" when the wobbler bellcrank is on the high point of the wobbler cam.



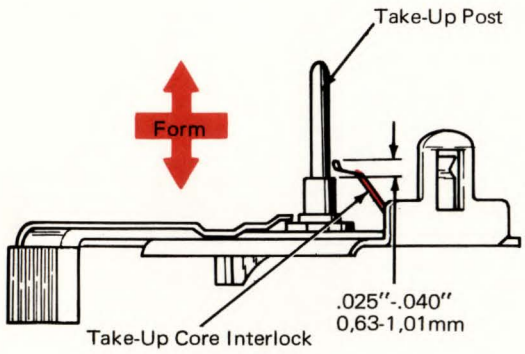
14. *Cartridge Guides* – Form the cartridge guides to center the ribbon take-up and supply cores within the holes in the top of the cartridge. Maintain .005"-.010" end play of the cartridge.



15. *Cartridge Retaining Springs* – Center the cartridge retaining springs in the holes in the cartridge guide lugs. Adjust the springs left to right so they positively hold the IBM Tech III ribbon cartridge down against the ribbon feed plate. Refine the right spring rotationally so the take-up core interlock clears the middle surface of the take-up post by .005"-.020".



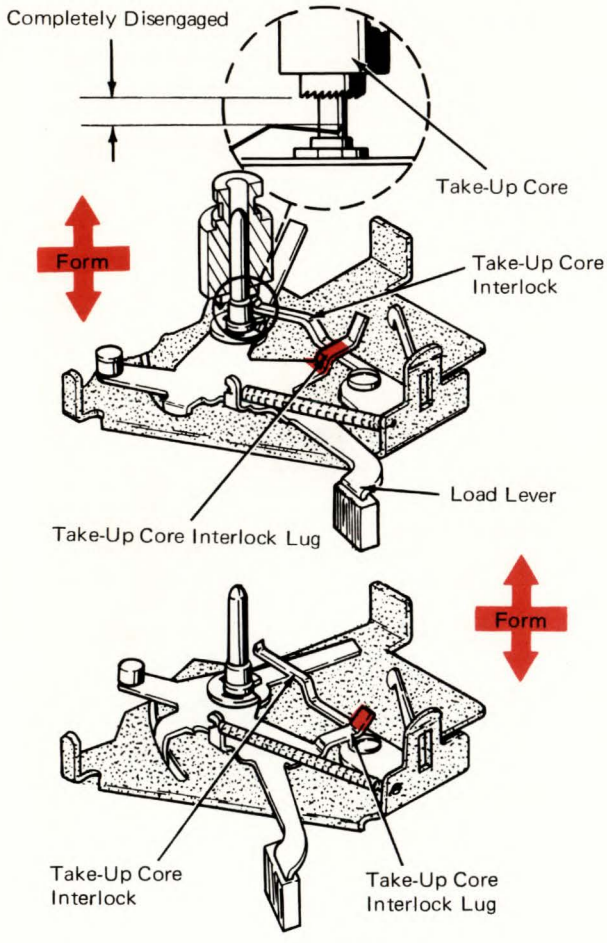
16. *Take-up Core Interlock* – Form the take-up core interlock so that in the load position the tip of the interlock is .025"-.040" above the top edge of the middle surface on the take-up post.



17. *Load Lever* – Form the take-up core interlock lug on the load lever to meet two conditions.

a. In the operate position, it must hold the take-up core interlock down completely disengaged from the take-up core.

b. When going from load to operate, the tip of the lug must clear the top surface of the take-up core interlock by a sufficient amount to reliably depress it.



ESCAPEMENT RACK REMOVAL

1. Remove the platen, deflector and feed rolls.
2. Disconnect the margin pitch link from the escapement rack gear.
3. Loosen the switch pitch sector gear screws and move it to the rear of the machine.
4. Remove the escapement rack gear.
5. Remove the escapement rack bearing plate and compression spring.
6. Disconnect the lower half backspace link and remove the half backspace intermediate lever and bellcrank link.
7. Remove the half backspace bellcrank mounting screw and spacer from the power frame.
8. Operate the tab to get the escapement pawl out of the escapement rack. As you pull the escapement rack from the machine, disengage and remove the half backspace bellcrank.
9. The following adjustments should be checked after the escapement rack is replaced.

    a. Half backspace motion
    b. Half backspace rest position
    c. Escapement rack gear
    d. Escapement rack gear lower stop
    e. Switch pitch sector gear
    f. Pitch cable

MARGIN RACK AND RAIL REMOVAL

1. Remove the margin rack gear toggle spring and gear guard.
2. Loosen the margin pitch link guide bracket.
3. Disconnect the margin release bracket spring.
4. Loosen the margin release bracket screws and slide the margin release bracket to the rear.
5. Disengage the margin sliders by holding the margin set levers to the rear. Slide the margin rack out of the machine. Note the position of the margin rack spring, washer and bushing.
6. Lift the margin rail out of the machine.
7. Remove the margin rack gear if necessary.
8. The following adjustments should be checked after the margin rack and rail are replaced.

    a. Margin pitch link guide bracket
    b. Margin rack gear
    c. Front margin rack gear stop

CARRIER RETURN/BACKSPACE CABLE DRUM ASSEMBLY REMOVAL

1. Position the carrier at the extreme right.
2. Remove the switch and swing it out of the way.
3. Carefully remove the mainspring.
4. Remove the backspace bellcrank retainer.
5. Remove the pin and C-clip connecting the driver links to the driver.
6. Remove the index interlock link and the left hand index interlock shaft clip. Slide the index interlock shaft toward the right.
7. Remove the index multiplying lever stop and switch bracket screws.
8. Remove the mainspring hub.
9. Remove the two screws that mount the paper feed support to its bracket.
10. Disconnect the backspace bellcrank spring.
11. Remove the mainspring backplate screws and remove the paper feed support bracket.
12. Slide the mainspring backplate from the escapement shaft leaving the backspace bellcrank in its position in front of the ratchet.
13. Remove the cable tension spring, arm and spacer.
14. Remove the CR/BS cable drum assembly and disengage the cable.
15. When installing a new drum assembly, engage the cable, orient it properly and install the cable tension spacer, arm and spring. This procedure will hold the cables in place.
16. Reinstall the remaining parts in reverse order.
17. The following adjustments should be checked:

    a. Paper feed support
    b. Switch bracket
    c. Mainspring hub
    d. Escapement shaft collar
    e. Transport cable tension
    f. Backspace motion
    g. Backspace latch height
    h. Index interlock shaft
    i. Index interlock paddle
    j. Index multiplying lever stop